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1996 Index of Wind Wave Directional Spectra Measured at Harvest Platform

by Charles E. Long

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Prepared for Headquarters, U.S. Army Corps of Engineers

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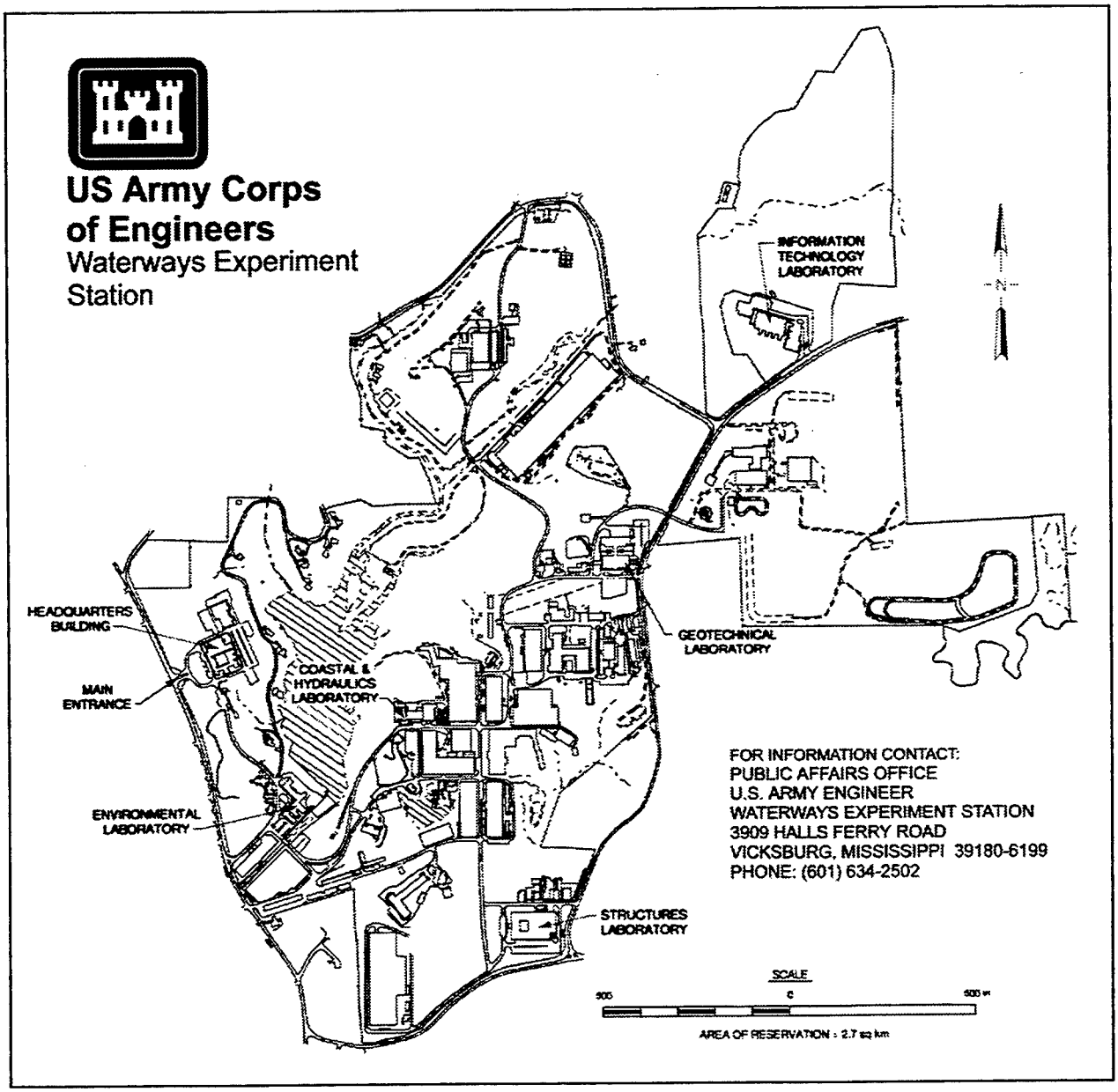

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Contents

Preface

This report indexes parameters of and describes means of access to a series of wind wave frequency-direction spectral observations made with a six-element, high-resolution directional wave gauge at Texaco Oil Company's Harvest Platform. The work was motivated by a need to publicize these results so they can be used by all investigators interested in natural wind wave energy distributions at a deepwater site near the exposed California coast. This effort was authorized by Headquarters, U.S. Army Corps of Engineers (HQUSACE), under Civil Works Coastal Navigation Hydrodynamics Program Research Work Unit 32484, "Directionality of Waves in Shallow Water." Funds were provided through the Coastal and Hydraulics Laboratory (CHL), U.S. Army Engineer Waterways Experiment Station (WES), under the program management of Ms. Carolyn M. Holmes, CHL. Messrs. John H. Lockhart, Jr., Charles Chesnutt, and Barry W. Holliday were HQUSACE Technical Monitors.

This report was prepared by Dr. Charles E. Long, under the direct supervision of Mr. William A. Birkemeier, Chief, Field Research Facility (FRF), CHL, and Mr. Thomas W. Richardson, Chief, Engineering Development Division (EDD), CHL. General supervision was provided by Dr. James R. Houston and Mr. Charles C. Calhoun, Jr., Director and Assistant Director, CHL, respectively.

Mr. David D. McGehee, Prototype Measurement and Analysis Branch, EDD, CHL, was instrumental in coordinating the efforts of CHL and the State of California in data archiving and gauge maintenance by the Coastal Data Information Program (CDIP) at Scripps Institution of Oceanography (SIO). Data transfer between SIO and the FRF was coordinated under the direction of Dr. Richard J. Seymour, CDIP, with particularly helpful assistance from Ms. Julianna Thomas, CDIP.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

1 Introduction

In late December 1992, a high-resolution directional wave measuring system became fully operational on Texaco Oil Company's Harvest Platform to make long-term observations of the deep-ocean wind wave climate in the vicinity of the Southern California Bight (Figure 1). Such observations are necessary to

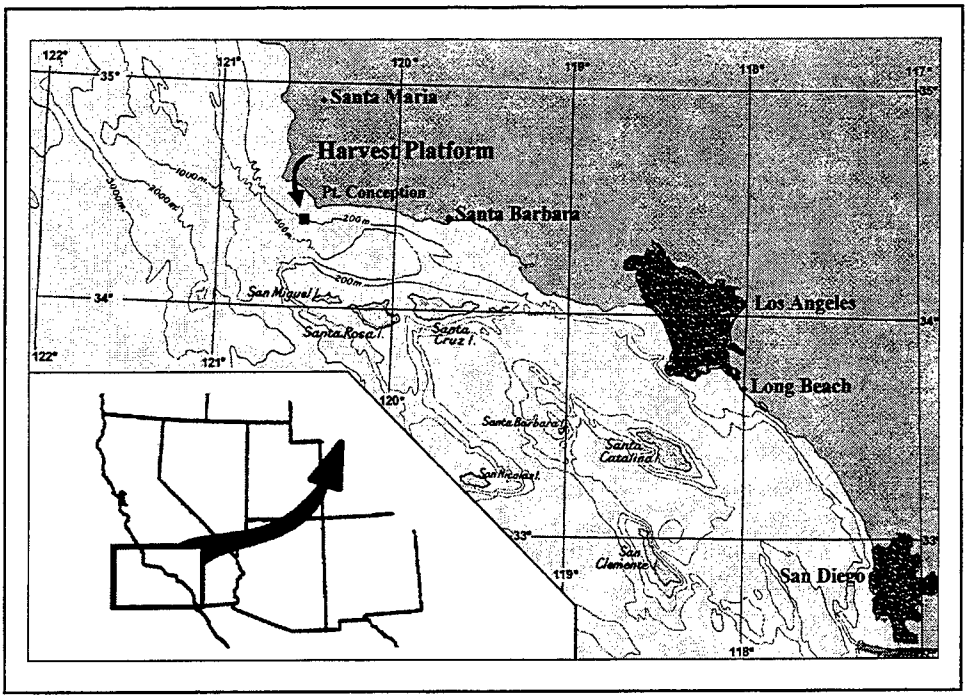

Figure 1. Southern California Bight and location of Harvest Platform

provide ground truth for interpreting satellite imagery of the ocean surface, test evolution and propagation models of open-ocean wind waves, and establish seaward boundary conditions for models of wave propagation and transformation from deep water to coastal regions. The purpose of this report is to encourage broad use of these observations by parametrically describing 1,610 wind wave frequency-direction spectral estimates obtained in calendar year 1996, and identifying a means whereby an investigator can access these spectra. These results are from the fourth year of collection, which is the final year of high-resolution analysis performed under this project. Results from the first three years are de-

scribed by Long (1995a, 1996, 1997). Raw data collection and conventional analysis continue to be conducted, as from the beginning, by the Coastal Data Information Program (CDIP), Ocean Engineering Research Group, Center for Coastal Studies, Scripps Institution of Oceanography, La Jolla, CA. More information about CDIP, including their analysis of Harvest Platform data for the period covered by this report, can be found on the World Wide Web at:

http://cdip.ucsd.edu

For completeness, this report briefly describes the directional gauge geometry and data collection scheme (Chapter 2), error checking procedures and basic directional estimation algorithm (Chapter 3), and definitions of parameters used to characterize the observations (Chapter 4). Appendix A contains a table of these characterizing parameters, and acts as an index for the 1996 database. Time series graphs of these parameters are presented in Appendix B. Chapter 5 describes how data can be obtained as well as the data format and file-naming scheme. Data format is illustrated in Appendix C, which lists a FORTRAN program that can read a data file, and Appendix D, which shows a sample data file.

2 Directional Gauge

Gauge Location and Array Geometry

As indicated in Figure 1, Harvest Platform is located about 20 km (10.8 n.m.) west of Point Conception, California, in water with a mean depth of 202 m (663 ft). Waves originating in the greater Pacific Ocean can reach the platform via relatively unobstructed paths from the north, west, and south. The mean water depth ensures deepwater wave conditions for waves with lengths shorter than about 400 m (1,312 ft), or frequencies higher than about 0.06 Hz. Spectra reported herein are processed at frequencies between 0.04 and 0.16 Hz, so it is likely that directional spectra for frequencies between 0.04 and 0.06 Hz are affected somewhat by refraction.

Directional wave detection is normally achieved with a spatial array of six subsurface pressure gauges mounted on the Harvest Platform framework. Figure 2 shows a plan view of relative gauge positions, and the array orientation in a geophysical reference frame. Gauge spacing takes advantage of the maximum horizontal dimensions of Harvest Platform, and allows directional estimation for waves in the frequency band noted in the previous paragraph. All gauges are mounted at a depth of 15.72 m (51.57 ft) below mean sea level, which ensures they will not protrude through the sea surface under extreme wave conditions that have been observed at this site.[1] To avoid aliasing in directional estimation, the lower resolution wavelength limit is two times the shortest lag spacing of the array. In the Harvest Platform array, this limit is 45.4 m (149.0 ft), which corresponds to a wave frequency of about 0.18 Hz. Signal analysis used in this report was limited further to 0.16 Hz to be conservatively clear of aliasing effects.

Pressure Gauges and Data Path

Individual sensors were Model TJE absolute pressure sensors manufactured by Sensotec Transducer Company with operating ranges of 0 to 100 psia (0 to 689.5 kPa), and a manufacturer's stated accuracy of ±0.1 percent of full scale. The six gauges on Harvest Platform were sampled simultaneously at 1 Hz,

[1] Personal communication, 1991, Dr. R. J. Seymour, CDIP.

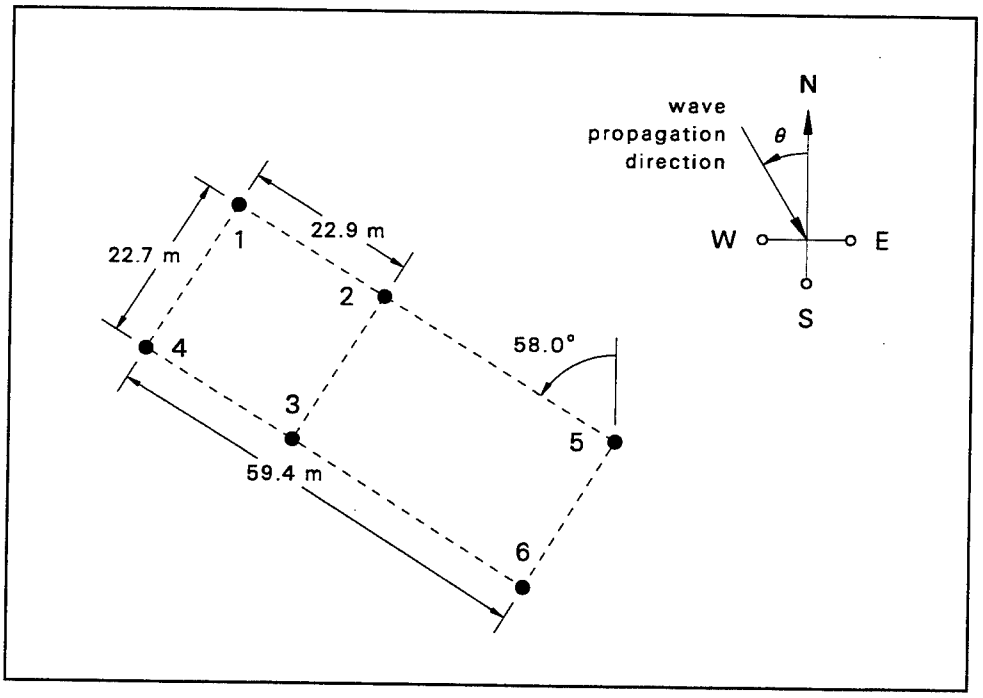

Figure 2. Dimensions and orientation of the Harvest Platform array

digitized, and then fed to a concentrator where the set of samples was buffered. Buffered signals were periodically transmitted to shore through a telephone connection, and ultimately stored as collection files on the main computer of CDIP. Each collection time series is 8,192 sec (2 hr 16 min 32 sec) in length.

Data processing for results presented in this report was not performed at the CDIP site, and so is independent of the processing done and published by that group (Scripps Institution of Oceanography, *Monthly reports*). Data collections were transferred to the Field Research Facility (FRF) of the U.S. Army Engineer Waterways Experiment Station's Coastal and Hydraulics Laboratory for processing by high-resolution techniques that are different from those used by CDIP. Data transfer was accomplished over an electronic network.

Collection Schedule and Data Set Size

Collections were made eight times daily, at approximately 3-hr intervals. Nominal collection start times were 0200, 0500, 0800, 1100, 1400, 1700, 2000, and 2300 Greenwich Mean Time (GMT). Actual collection start times varied by several minutes on either side of these nominal start times because the amount of time required to establish a phone link varied from collection to collection. There are several periods of several days duration where collections are virtually continuous. These occur when CDIP shifts to a collection mode intended to detect tsunami waves, and result in up to 12 directional spectral estimates daily instead of the normal eight.

Data discussed in this report covers 1996 up to September 17, at which time data collection ceased for a major overhaul of the Harvest Platform array, and after which the high-resolution data analysis project ended. Of the possible 2,088 collections during this period (assuming eight collections per day), a total of 1,610 collections were acquired and processed as frequency-direction spectra. A number of collections were lost because of the inability to establish or maintain electrically clean phone links to the concentrator on Harvest Platform. An additional number of collections were not processed because data did not satisfy error-checking constraints described in Chapter 3 of this report.

3 Primary Data Analysis

Primary data processing was done by checking data quality through a series of spectral intercomparisons, and, for data of sufficient quality, computing frequency-direction spectra. All steps rely on Fourier analysis of pressure gauge time series data, and subsequent computation of cross-spectral densities. A discussion of error-checking procedures then leads logically to the subsequent steps involved in frequency-direction spectral computation.

Error Checking

The first step in data processing is computation of discrete estimates of frequency autospectra of pressure signals, and surface-corrected cross-spectral densities of signals from all pairs of gauges. Cross spectra are denoted in complex form as $C_{ij}(f_n) - iQ_{ij}(f_n)$, where $C_{ij}(f_n)$ is the coincident spectrum, $Q_{ij}(f_n)$ is the quadrature spectrum, i and j (as subscripts) are indices ranging in value from 1 to 6 that refer to the gauge numbers shown in Figure 2, and f_n is the n^{th} of a set of N discrete frequencies.[1] Frequency autospectra are denoted $S(f_n)$, and, if surface corrected with the linear wave pressure response function (Dean and Dalrymple 1984), are identically equal to $C_{ii}(f_n)$. All spectra are computed using Welch's method (Welch 1967) with standard Fourier analysis techniques (Bendat and Piersol 1971).

In a collection, the 8,192-sec time series from each gauge is analyzed in 15 half-lapped segments of 1,024 sec duration. Each segment is demeaned, tapered with a variance-preserving window, and converted to the frequency domain with a discrete Fourier transform. At this point, the analysis is split into two parts: estimates of pressure autospectra from each gauge at depth, and estimates of surface-corrected cross spectra of sea surface displacement. Raw cross-spectral estimates are formed for all gauge pairs using temporally corresponding transformed segments of pressure data corrected to represent sea surface displacement. Raw autospectral estimates are formed for each of the 15 transform segments for each individual gauge. At the error-checking stage, autospectral estimates are not surface corrected.

[1] For convenience, symbols and abbreviations are listed in the notation (Appendix E).

For both autospectra and cross spectra, smooth estimates are formed by averaging raw estimates over all 15 segments, and averaging results over 10 adjacent frequency bands. Final resolution frequency bandwidth is $df = 0.00977$ Hz, and the pass band of frequencies ranges from 0.044 to 0.162 Hz, which corresponds to ($N =$) 13 discrete frequency bands. Degrees of freedom for spectral estimates range from 160 to about 200, depending on the extent to which the second halves of time series segments are correlated with the first halves (Welch 1967).

Autospectral intercomparisons

One part of error checking is a graphic intercomparison of signal means and autospectra, an example of which is shown in the lower left graph of Figure 3. Frequency autospectral estimates of data from all six pressure gauges are plotted on the same set of axes from the first resolvable frequency band out to the temporal Nyquist frequency. If a pressure gauge is malfunctioning, its autospectrum will deviate obviously from the main group of curves. In the example shown in Figure 3, data from gauge 3 are clearly deviate and thus were not used in directional estimates for that collection.

The small inset graph in the lower left graph of Figure 3 is an analysis of signal means. The closely packed group of symbols of nearly constant value represents the deviations of the segment means from the median of the set of segment means for each of the 15 segments. If a gauge develops signal drift problems, it will be obvious as a symbol that deviates from the main group of symbols. Triangle symbols in the small inset graph show the deviation of the indicated water surface from mean sea level (gauge height off the bottom plus median of gauge mean depths for each segment minus the total long-term mean ocean depth of 202 m), and is therefore an indication of tide stage at Harvest Platform for each of the 15 segments in a collection.

Coherence and phase comparisons

The next step in error checking is computation of a dimensionless cross spectrum $M_{ij}(f_n)$, defined by

$$M_{ij}(f_n) = \frac{C_{ij}(f_n) - iQ_{ij}(f_n)}{\sqrt{C_{ii}(f_n)}\,\sqrt{C_{jj}(f_n)}} \tag{1}$$

Equation 1 is used in error checking in the form of coherence and phase estimates. Coherence of signals from gauges i and j at discrete frequency f_n is

$$\Gamma^2_{ij}(f_n) = |\, M_{ij}(f_n) \,|^2 \tag{2}$$

Signal phase difference of gauge i relative to gauge j at frequency f_n is

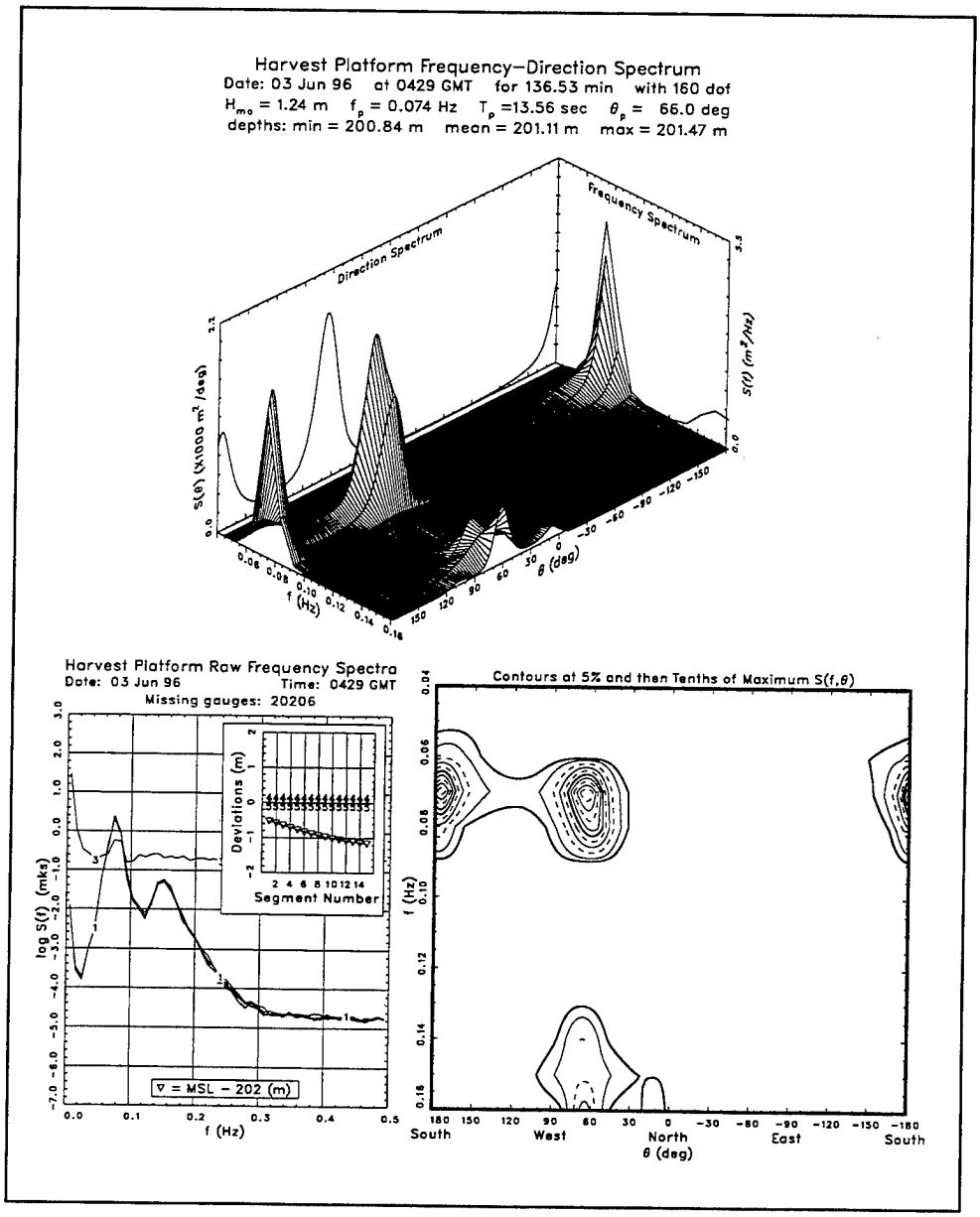

Figure 3. Autospectral intercomparison and frequency-direction spectral estimate

$$\phi_{ij}(f_n) = \tan^{-1}\left(\frac{\mathrm{Im}[M_{ij}(f_n)]}{\mathrm{Re}[M_{ij}(f_n)]}\right) \tag{3}$$

where Re[ ] and Im[ ] are the real and imaginary parts, respectively, of the entity contained in square brackets.

Signals from multiple pairs of gauges having redundant lag (or spatial separation) vectors in a uniform wave field are expected to have identical cross spectra.

In the Harvest Platform array there are several such sets of pairs as can be seen in Figure 2. In terms of coherences and phases, one would expect

$$\Gamma_{14}(f_n) = \Gamma_{23}(f_n) = \Gamma_{56}(f_n) \qquad \phi_{14}(f_n) = \phi_{23}(f_n) = \phi_{56}(f_n) \tag{4}$$

as well as

$$\Gamma_{12}(f_n) = \Gamma_{43}(f_n) \qquad \phi_{12}(f_n) = \phi_{43}(f_n) \tag{5}$$

and

$$\Gamma_{15}(f_n) = \Gamma_{46}(f_n) \qquad \phi_{15}(f_n) = \phi_{46}(f_n) \tag{6}$$

Figure 4 is an example of coherence and phase comparisons, showing graphs of the functions named in Equations 4, 5, and 6 (upper, middle, and lower sets of graphs in Figure 4, respectively). This type of error checking is useful for isolating cases where a data point is dropped during telephone transmission from the data buffer, resulting in an apparent temporal shift of data from one gauge relative to data from the other gauges. Such a shift causes a significant phase error in cross spectra, and normally is readily apparent in a graphic display like Figure 4. Multiple gauge failures during 1996 made this test less useful than in other years because there were seldom enough redundant gauge pairs for an intercomparison. This test was retained during 1996, however, because it still contained useful information. For example, Figure 4 shows low coherence between gauges 2 and 3, and also between gauges 4 and 3, suggesting that data from gauge 3 were suspect, and reinforcing the conclusion derived from the frequency spectra shown in Figure 3.

The combined effects of intercomparing frequency autospectra and coherence and phase functions for the pressure gauge array on Harvest Platform provide clear indications of faulty or suspect data. In previous years (Long 1995a, 1996), when such conditions were detected in a collection, frequency-direction spectra were not computed. With the failure of gauge 6 early in 1995 (Long 1997), and the sporadic behavior of gauges 3 and 5 in 1996, this strict constraint was relaxed to optimize use of available data. For 1996, frequency-direction spectra were computed as long as at least three noncolinear gauges were functioning.

Frequency-Direction Spectra

Estimates of frequency-direction spectra are made using the iterative maximum likelihood estimator (IMLE) developed by Pawka (1983). Estimates are made by iterative approximations of directional distribution functions $D(f_n, \theta_m)$, which are related to corresponding frequency-direction spectra $S(f_n, \theta_m)$ by

$$D(f_n, \theta_m) = \frac{S(f_n, \theta_m)}{S(f_n)} \tag{7}$$

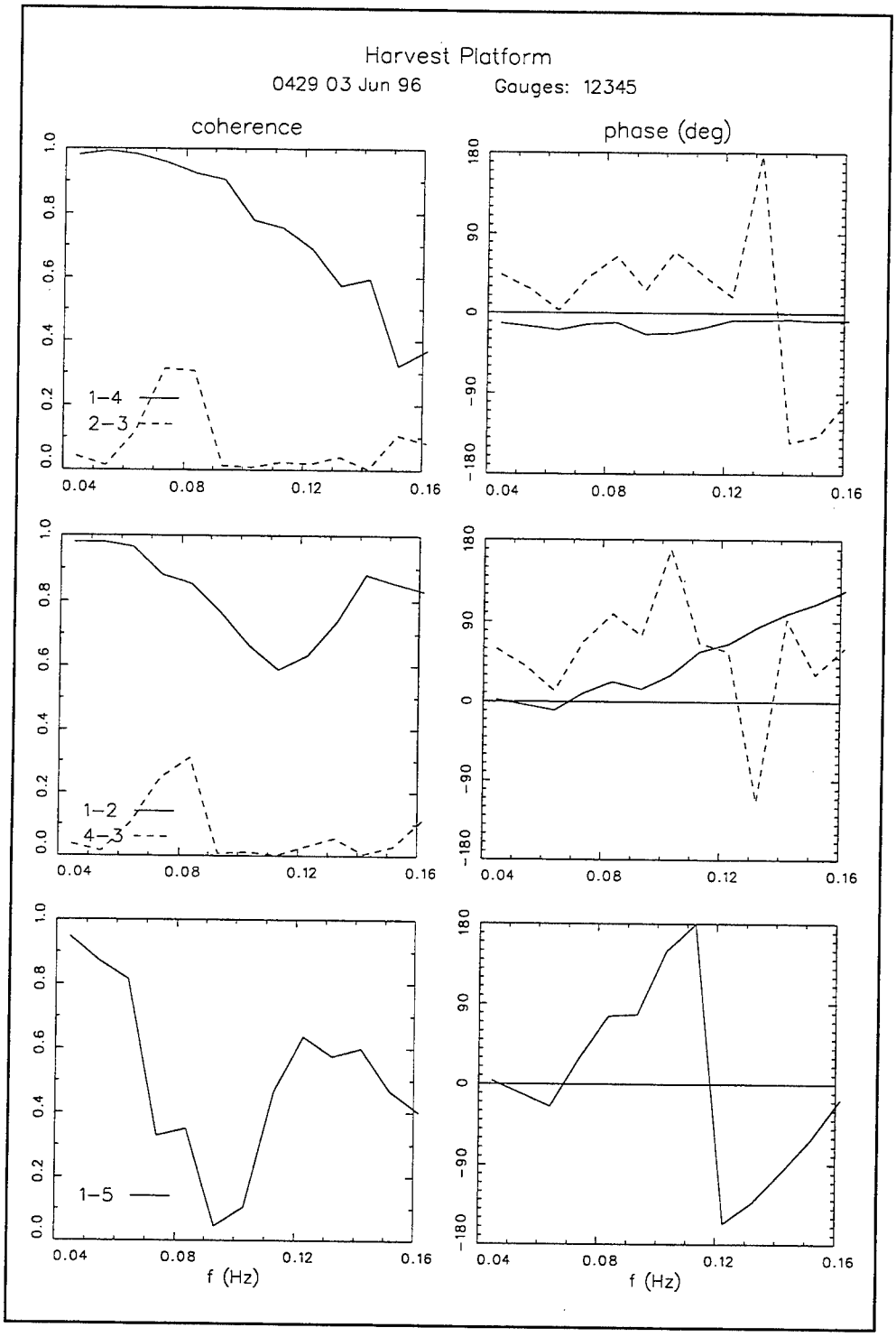

Figure 4. Sample coherence and phase function comparisons

where θ_m is a discrete angle indicating the direction from which wave energy arrives, measured counterclockwise from true north (Figure 2), and $S(f_n)$ is the (surface-corrected) frequency spectrum. The direction index m ranges from

$m = 1$ to $m = M = 181$, while direction ranges from $\theta_1 = -180$ deg to $\theta_{181} = 180$ deg in steps of $d\theta = 2$ deg. The directional distribution function has the property

$$\sum_{m=1}^{M} D(f_n, \theta_m)\, d\theta = 1 \tag{8}$$

which must be satisfied in all estimates.

The lowest order estimate is the maximum likelihood estimate described by Davis and Regier (1977), which takes the form

$$D_0(f_n, \theta_m) = \frac{a_0}{d\theta \sum_{i=1}^{I} \sum_{j=1}^{I} M_{ij}^{-1}(f_n)\, e^{i\vec{k}_n(\theta_m)\cdot(\vec{x}_i - \vec{x}_j)}} \tag{9}$$

where a_0 is a factor of order 1 that is used to satisfy Equation 8, I is the number of gauges, the $M_{ij}^{-1}(f_n)$ are elements of the inverse of the dimensionless cross-spectral matrix defined by Equation 1, $\vec{k}_n(\theta_m)$ is wave number vector, and $\vec{x}_i$ and $\vec{x}_j$ are coordinate position vectors of gauges i and j, respectively. The wave number vector $\vec{k}_n(\theta_m)$ is

$$\vec{k}_n(\theta_m) = k_n \cos\theta_m\, \hat{e}_x + k_n \sin\theta_m\, \hat{e}_y \tag{10}$$

where $\hat{e}_x$ and $\hat{e}_y$ are spatial coordinate unit vectors in the x- and y-directions, respectively, and k_n is wave number vector magnitude, which is related with gravitational acceleration g to frequency f_n and water depth d through the linear wave dispersion relation

$$4\pi^2 f_n^2 = g\, k_n \tanh k_n d \tag{11}$$

As used in this report, horizontal coordinates are such that x increases to the north, and y increases to the west.

An IMLE result is achieved by iterating through several computational steps. At the r^{th} iteration, an estimate ${}^{r}M_{ij}(f_n)$ of the observed cross-spectral matrix $M_{ij}(f_n)$ is computed from the previous directional distribution function estimate $D_{r-1}(f_n, \theta_m)$ by

$${}^{r}M_{ij}(f_n) = \sum_{m=1}^{M} D_{r-1}(f_n, \theta_m)\, e^{i\vec{k}_n(\theta_m)\cdot(\vec{x}_i - \vec{x}_j)}\, d\theta \tag{12}$$

A new intermediate directional distribution function estimate $D_r'(f_n,\theta_m)$ is computed using the cross-spectral matrix of Equation 12 in the expression

$$D_r'(f_n,\theta_m) = \frac{a_r}{d\theta \sum_{i=1}^{I}\sum_{j=1}^{I} {}^rM_{ij}^{-1}(f_n)\, e^{i\vec{k}_n(\theta_m)\cdot(\vec{x}_i-\vec{x}_j)}} \tag{13}$$

where a_r is adjusted so that Equation 8 is satisfied for $D_r'(f_n,\theta_m)$, and ${}^rM_{ij}^{-1}(f_n)$ are elements of the inverse of the matrix defined by Equation 12. A correction is found for $D_r'(f_n,\theta_m)$ by first computing

$$\lambda_r(f_n,\theta_m) = 1 - \frac{D_r'(f_n,\theta_m)}{D_0(f_n,\theta_m)} \tag{14}$$

and then finding a new directional distribution function estimate $D_r(f_n,\theta_m)$ from

$$D_r(f_n,\theta_m) = D_r'(f_n,\theta_m)\left[1 + \frac{|\lambda_r(f_n,\theta_m)|^{\beta+1}}{\gamma\,\lambda_r(f_n,\theta_m)}\right] \tag{15}$$

The parameters β and γ in Equation 15 control the rate of convergence of the estimator. As used by Pawka (1983), the values $\beta = 1$ and $\gamma = 5$ were used for all estimates discussed in this report.

In each iterative loop, a convergence check ϵ_r is computed as the sum of the squares of the magnitudes of the differences of elements of the estimated cross spectrum of Equation 12 and the measured cross spectrum of Equation 1. This takes the form

$$\epsilon_r = \sum_{i=1}^{I}\sum_{j=1}^{I} |{}^rM_{ij}(f_n) - M_{ij}(f_n)|^2 \tag{16}$$

Iteration continues as long as ϵ_r decreases between successive iterations, or until an upper limit R of iterations has been completed. In computations reported herein, $R = 30$.

Equations 9 to 16 form the basis of the IMLE technique. For the iteration r that satisfies the convergence check, the frequency-direction spectrum at frequency f_n is formed from

$$S(f_n,\theta_m) = S(f_n)\,D_r(f_n,\theta_m) \tag{17}$$

The complete frequency-direction spectrum is formed when Equations 9 through 17 are evaluated for all frequencies.

An example of such a spectrum is illustrated in Figure 3. The upper graph is a three-dimensional plot of $S(f_n, \theta_m)$, and the lower right graph is a contour plot of the spectrum. The right panel in the three-dimensional plot is a linear graph of the discrete frequency spectrum $S(f_n)$, which is related to the frequency-direction spectrum through Equations 7 and 8 by

$$S(f_n) = \sum_{m=1}^{M} S(f_n, \theta_m)\, d\theta \tag{18}$$

The left panel in the three-dimension plot is a linear graph of the direction spectrum $S(\theta_m)$, which is the directional analog of the frequency spectrum. The direction spectrum is defined by

$$S(\theta_m) = \sum_{n=1}^{N} S(f_n, \theta_m)\, df \tag{19}$$

Because $S(\theta_m)$ represents total wave energy in each direction bin, it is a particularly useful function from which to derive direction-sensitive characterizing parameters for a given frequency-direction spectrum as a whole. A set of such characterizing parameters is defined in Chapter 4.

Special Notes for 1996

As noted previously, gauge 6 (Figure 2) failed during 1995, and was not repaired during the time covered by this report. Also, gauges 3 and 5 behaved somewhat sporadically following a large storm along the U.S. west coast in December 1995, and data from gauge 3 became unusable in the final week of February 1996. The storm disrupted communication with Harvest Platform, and repairs to the communication system were not effected until the second week of February 1996. With a major overhaul of the Harvest Platform array in September 1996, and subsequent conclusion of data analysis by FRF, the effective period of nearly continuous data coverage during 1996 was from 8 February to 17 September.

Within that time frame, the number of gauges with satisfactory data varied from three to five. Figure 5 illustrates which gauges were used for analysis in all collections processed by the FRF during 1996. From 8 to 22 February, most collections had five satisfactory gauges. After 22 February, data from gauge 3 consistently failed data quality checks, reducing the total number of potentially useful gauges to four. In much of March and April, and sporadically through the rest of the year, data from gauge 5 failed data quality checks, reducing the number of useful gauges to three, with analysis being performed using data from

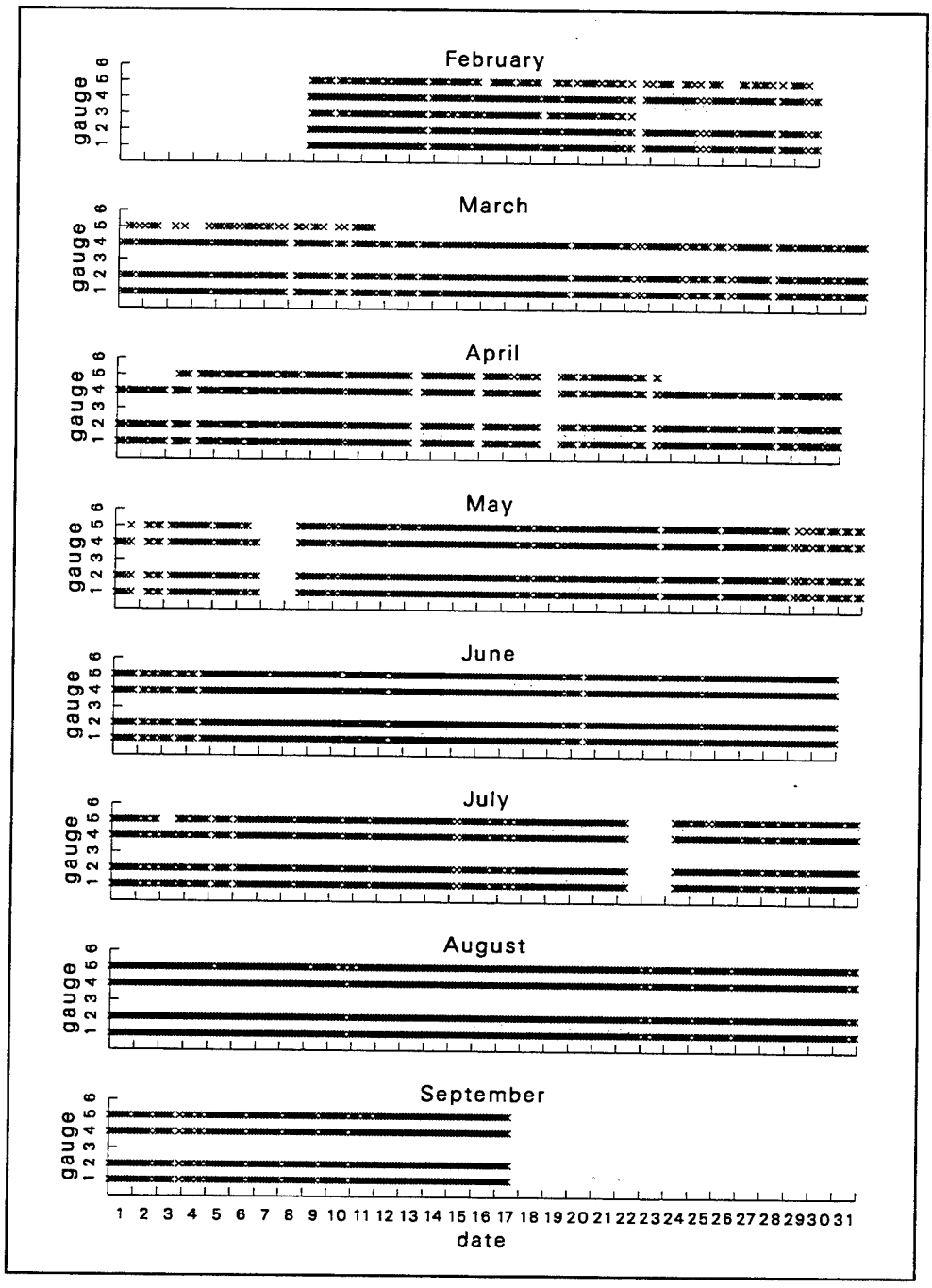

Figure 5. Time line of Harvest Platform gauges used for analysis

gauges 1, 2, and 4. For the remainder of the time shown in Figure 5, the usefully functioning array consisted of gauges 1, 2, 4, and 5.

As a result of the reduced number of functioning gauges, especially where there are only three, the advantages of high-resolution techniques over conventional analysis (e.g., as done by CDIP) are nearly lost. Frequency-direction spectra based on IMLE analysis of data from three pressure gauges will have attributes comparable to those that would be obtained by the method of Oltman-Shay

and Guza (1984) for data from a heave-pitch-roll buoy. Directional parameters, such as mean wave direction, are comparable in accuracy to those reported by CDIP, and directional distribution functions should be used with some caution.

4 Characterizing Parameters

To effect a summary description of the Harvest Platform database, frequency-direction spectra are characterized with a set of parameters. These descriptors are called bulk parameters because they are derived from extremal or integral properties of spectra, and so represent only part of the frequently more complicated directional structure of the wind wave field. A more exhaustive treatment of directional spectral structure at Harvest Platform is given by Long (1995b). For the purposes of the present report, nine parameters are used. These parameters are: characteristic wave height, peak frequency, two measures of characteristic direction, two measures of directional spread, two measures of asymmetry of directionally distributed wave energy, and a measure of kurtosis of directional distributions. This chapter contains the mathematical definitions of these parameters.

Wave Height, Peak Frequency, and Peak Direction

Characteristic wave height H_{mo} is defined using the conventional definition of four times the standard deviation of sea surface displacement. H_{mo} can be defined in terms of the full frequency-direction spectrum, the frequency spectrum defined by Equation 18, or the direction spectrum defined by Equation 19. A definition that relates all of these entities is

$$\frac{H_{mo}^2}{16} = \sum_{m=1}^{M} \sum_{n=1}^{N} S(f_n, \theta_m)\, df\, d\theta = \sum_{n=1}^{N} S(f_n)\, df = \sum_{m=1}^{M} S(\theta_m)\, d\theta \qquad (20)$$

It should be noted that H_{mo} reported herein is lower than what would be found in conventional analysis because directional computations were truncated at 0.16 Hz instead of the nominal 0.3-Hz limit for wind waves. Consequently, contributions to H_{mo} from high-frequency parts of wind wave spectra are not represented.

Peak frequency f_p is defined as the discrete frequency at which the frequency spectrum $S(f_n)$ is maximum. This definition is conventional, in that it is the usual characteristic frequency defined for nondirectional gauges. For convenience, Appendix A lists both f_p and its inverse, peak period T_p ($= 1/f_p$).

Peak direction θ_p is defined as the direction of maximum variance density in the directional distribution associated with the peak frequency. In symbols, θ_p is the discrete direction at which $S(f_p, \theta_m)$ is a maximum. It is interpreted as the direction of the most energetic waves at the frequency containing the greatest overall energy.

Circular Moment Parameters

Kuik, van Vledder, and Holthuijsen (1988) proposed a useful set of parameters that define mean wave direction, directional spread, skewness, and kurtosis based on circular moments of directional distribution functions. Though derived for directional distributions at individual frequencies, the definitions can be applied to any directional distribution function. For the purposes of characterizing a frequency-direction spectrum as a whole, the direction spectrum $S(\theta_m)$, as defined by Equation 19, is used herein because it represents total wave energy in any given direction arc.

To define a directional distribution function (one that integrates to unit area) from the direction spectrum, $S(\theta_m)$ must be normalized by its own area. By Equation 20, this area is identically $\frac{1}{16} H_{mo}^2$, so the appropriate directional distribution function is

$$D(\theta_m) = \frac{16}{H_{mo}^2} S(\theta_m) \qquad m = 1, 2, \ldots, M \tag{21}$$

Circular moments in terms of $D(\theta_m)$ adapted from definitions by Kuik, van Vledder, and Holthuijsen (1988) are

$$m_1 = \sum_{m=1}^{M} \cos(\theta_m - \theta_0) D(\theta_m) d\theta \tag{22}$$

$$n_1 = \sum_{m=1}^{M} \sin(\theta_m - \theta_0) D(\theta_m) d\theta \tag{23}$$

$$m_2 = \sum_{m=1}^{M} \cos(2\theta_m - 2\theta_0) D(\theta_m) d\theta \tag{24}$$

$$n_2 = \sum_{m=1}^{M} \sin(2\theta_m - 2\theta_0) D(\theta_m) d\theta \tag{25}$$

where θ_0 is the mean direction defined by requiring $n_1 = 0$. With this constraint, Equation 23 can be solved to find

$$\theta_0 = \tan^{-1}\left[\frac{\sum_{m=1}^{M} D(\theta_m)\sin\theta_m\, d\theta}{\sum_{m=1}^{M} D(\theta_m)\cos\theta_m\, d\theta}\right] \tag{26}$$

With θ_0 determined by Equation 26, moments m_1, m_2, and n_2 can be computed from Equations 22, 24, and 25, respectively.

Kuik, van Vledder, and Holthuijsen (1988) define a measure of directional spread (herein called *circular width*) σ as

$$\sigma = (2 - 2m_1)^{1/2} \tag{27}$$

a measure of asymmetry of a directional distribution (*circular skewness*) γ as

$$\gamma = \frac{-n_2}{\left(\frac{1}{2} - \frac{1}{2}m_2\right)^{3/2}} \tag{28}$$

and a measure of the flatness of a directional distribution (*circular kurtosis*) δ as

$$\delta = \frac{6 - 8m_1 + 2m_2}{(2 - 2m_1)^2} \tag{29}$$

Quartile Parameters

Two parameters that are modestly more intuitive than the corresponding circular parameters, and are also useful for characterizing spread and asymmetry in a directional distribution function are the *quartile spread* $\Delta\theta$ and *quartile asymmetry* A used by Long and Oltman-Shay (1991). The concept is based on the fact that any directional distribution function integrates to unity such that an integral from the direction of minimum energy $\theta_{m_{min}}$ (where m_{min} is the discrete direction index at which minimum energy occurs) to any arbitrary angle creates a function $I(\theta_m - \theta_{m_{min}})$ that increases monotonically from zero to an upper limit of unity. The directions at which this integral (interpolated as necessary from discrete data) has the values $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ are the first quartile, median, and third

quartile directions of the directional distribution, respectively. Differences among these directions then provide information about the spread and asymmetry of the distribution.

Using $D(\theta_m)$ as a representative directional distribution function, the integral function is

$$I(\theta_m - \theta_{m_{min}}) = \sum_{l=m_{min}}^{m} D(\theta_l)\, d\theta \tag{30}$$

where θ_l is the dummy discrete independent variable of summation, and the cyclic nature of the distribution function is employed if necessary. Quartile directions satisfy

$$I(\theta_{25\%} - \theta_{m_{min}}) = 0.25 \tag{31}$$

$$I(\theta_{50\%} - \theta_{m_{min}}) = 0.50 \tag{32}$$

and

$$I(\theta_{75\%} - \theta_{m_{min}}) = 0.75 \tag{33}$$

A measure of directional spread $\Delta\theta$ is the span of the two middle quartiles

$$\Delta\theta = \theta_{75\%} - \theta_{25\%} \tag{34}$$

and has the specific interpretation that it is the arc subtending the central 50 percent of the energy distribution.

A measure of asymmetry of a distribution is the ratio of the directional width of the third quartile to that of the second quartile. By taking the natural logarithm of this ratio, a symmetric distribution has an asymmetry parameter A near zero, and that for a skewed distribution acquires a positive or negative sign if the skewness is toward larger or smaller angles, respectively. The asymmetry parameter is thus defined as

$$A = \ln\left[\frac{\theta_{75\%} - \theta_{50\%}}{\theta_{50\%} - \theta_{25\%}}\right] \tag{35}$$

Summary of Parameters

The nine bulk parameters (H_{mo}, f_p, θ_p, θ_0, σ, γ, δ, $\Delta\theta$, and A) defined here are useful for classifying general wind wave energy distributions. For reference as an index of processed data from the 1996 collection year, these parameters are listed in Appendix A, and plotted as time series in Appendix B. Graphs in Appendix B provide an overview of the directional wave climate at Harvest Platform, and specific parametric values can be determined from the listing in Appendix A. An evaluation of the accuracy of these parameters, relationships among these parameters, and examples of frequency-direction spectra classified by ranges of these parameters are given by Long (1995b).

5 Accessing Spectra

Frequency-direction spectra computed from Harvest Platform data are currently stored on electro-optical media in binary, unformatted form, and so are not "on-line" in the sense of common data networks. Nonetheless, an individual interested in obtaining these spectra can readily do so by communicating with the FRF via:

Surface mail	Chief, Field Research Facility 1261 Duck Road Kitty Hawk, NC 27949-4472
Telephone	(919) 261-3511
FAX	(919) 261-4432

or any of the following internet addresses:

c.long@cerc.wes.army.mil
c.baron@cerc.wes.army.mil
w.birkemeier@cerc.wes.army.mil

On request, all or part of the spectral database can be converted to 80-column ASCII format and copied either to portable magnetic tape media or to an anonymous file transfer protocol (ftp) account that is accessible through common computer networks. Data will be in the form of a set of files with one spectral estimate per file. Files will be named HP*yymmddhhmm*.ASC, where *yymmdd* represents year, month, and day, and *hhmm* represents hour and minute (GMT) of a collection start time from which a spectrum is estimated. For convenience, dates and times of parameter listings in Appendix A are in the *yymmdd* and *hhmm* mnemonic forms.

On receipt by a user, spectral data files can be read using the format statements shown in the sample FORTRAN program listed in Appendix C. The header of the FORTRAN program listing identifies all the variables contained in a data file. For reference, Appendix D is a listing of a sample data file, and shows locations of variables within the file.

6 Summary

This is the fourth and final of a series of reports describing results from a high-resolution directional wave gauge installed on the Texaco Oil Company Harvest Platform. The purpose of this gauge is long-term monitoring of the directional wind wave climate at a deepwater site that can be used to represent open ocean conditions for waves approaching the coast of southern California. This report indexes parameters of and describes a means of access to 1,610 frequency-direction spectral observations made during calendar year 1996.

The primary intent of this report is to publicize these observations so that they can be used by researchers interested in seaward boundary conditions in coastal wave propagation models, studies of ocean wave evolution, comparison studies with locally deployed low-resolution directional wave gauges, and ground truth in remote sensing research. Improved knowledge resulting from such studies will enhance abilities to model the physics of open ocean wave processes, and the consequent nearshore wave climate required in coastal engineering computations as such waves propagate landward.

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Appendix A
Table of Collection Times and Bulk Parameters

Table A1
Collection Times and Bulk Parameters

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	$\Delta\theta$ deg	A
960208	2012	2.78	0.083	12.0	80	78	0.41	-0.09	6.68	23	-0.08
960208	2234	2.74	0.083	12.0	78	78	0.42	0.10	7.37	20	0.04
960209	0134	2.59	0.064	15.6	74	75	0.44	0.33	7.27	22	0.13
960209	0435	2.87	0.064	15.6	76	78	0.40	0.21	7.52	22	0.08
960209	0734	2.72	0.064	15.6	76	78	0.39	0.33	8.80	20	0.13
960209	1035	2.61	0.064	15.6	78	80	0.39	0.32	9.24	20	0.05
960209	1334	3.06	0.074	13.6	76	79	0.38	0.14	9.41	19	0.18
960209	1634	3.20	0.064	15.6	82	82	0.38	0.14	9.29	19	-0.02
960209	1934	2.97	0.064	15.6	84	84	0.36	0.16	10.30	17	-0.01
960209	2234	2.61	0.064	15.6	86	84	0.38	0.38	10.23	17	-0.20
960210	0132	2.60	0.064	15.6	78	82	0.39	0.35	9.59	20	0.14
960210	0434	2.75	0.064	15.6	82	82	0.38	0.24	9.61	19	0.06
960210	0734	2.60	0.064	15.6	82	83	0.37	0.05	9.86	19	0.02
960210	1034	2.53	0.064	15.6	84	83	0.39	0.27	9.44	18	-0.08
960210	1331	2.68	0.064	15.6	82	82	0.41	0.22	8.68	19	-0.03
960210	1634	2.81	0.064	15.6	82	78	0.39	0.09	7.82	23	-0.11
960210	1934	2.72	0.064	15.6	80	77	0.39	0.23	8.28	22	-0.12
960210	2234	2.51	0.064	15.6	80	75	0.41	0.25	7.55	24	-0.09
960211	0133	2.27	0.074	13.6	70	75	0.42	0.45	7.88	25	0.14
960211	0435	2.51	0.074	13.6	84	77	0.39	0.30	7.93	25	-0.28
960211	0734	2.25	0.074	13.6	78	75	0.40	0.47	8.43	22	-0.13
960211	1034	2.01	0.074	13.6	82	75	0.47	0.22	5.71	32	-0.24
960211	1335	1.94	0.074	13.6	76	76	0.46	0.62	7.20	24	-0.10
960211	1635	1.78	0.074	13.6	74	76	0.46	0.77	6.83	24	0.05
960211	1935	1.64	0.074	13.6	84	76	0.46	0.48	5.68	32	-0.18
960211	2308	1.60	0.074	13.6	70	72	0.47	0.58	6.00	27	0.06
960212	0134	1.58	0.074	13.6	80	72	0.49	0.42	5.38	32	-0.20
960212	0434	1.50	0.074	13.6	74	77	0.65	1.58	5.82	25	0.13
960212	0734	1.53	0.074	13.6	74	74	0.44	0.52	7.72	22	0.04
960212	1008	1.63	0.054	18.5	72	74	0.44	0.63	7.86	20	0.08

(Sheet 1 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960212	1333	1.95	0.054	18.5	78	76	0.44	0.32	7.58	21	-0.11
960212	1624	2.11	0.054	18.5	78	77	0.44	0.26	7.85	20	0.01
960212	1933	2.15	0.064	15.6	78	78	0.45	0.49	8.81	17	0.07
960212	2233	2.27	0.064	15.6	78	78	0.40	0.17	9.53	18	-0.06
960213	0133	2.31	0.064	15.6	80	78	0.43	-0.07	9.18	17	-0.05
960213	0430	2.66	0.064	15.6	76	78	0.40	0.08	9.10	18	0.11
960213	0726	2.42	0.064	15.6	72	75	0.41	0.37	8.55	21	0.16
960213	1057	2.26	0.064	15.6	80	77	0.41	0.45	9.38	19	-0.15
960213	1330	2.10	0.064	15.6	78	77	0.43	0.42	8.76	19	-0.03
960213	2230	1.98	0.064	15.6	70	75	0.42	1.02	8.77	20	0.29
960214	0127	1.90	0.074	13.6	72	75	0.43	0.81	8.69	21	0.17
960214	0430	1.87	0.074	13.6	78	76	0.51	0.86	7.36	24	-0.23
960214	0730	1.77	0.074	13.6	68	74	0.43	1.44	9.52	19	0.19
960214	1030	1.46	0.064	15.6	72	75	0.49	1.59	7.94	20	0.09
960214	1334	1.49	0.074	13.6	74	75	0.46	1.13	7.93	22	0.02
960214	1634	1.39	0.074	13.6	64	72	0.50	1.63	7.24	25	0.29
960214	1935	1.43	0.074	13.6	64	72	0.51	1.47	6.69	27	0.31
960214	2235	1.39	0.074	13.6	70	74	0.52	1.37	6.92	20	0.16
960215	0203	1.43	0.074	13.6	70	74	0.53	1.27	5.80	27	0.14
960215	0434	1.35	0.074	13.6	68	76	0.60	1.16	5.24	32	0.27
960215	0734	1.30	0.083	12.0	70	79	0.57	1.14	5.04	34	0.32
960215	1035	1.22	0.074	13.6	68	85	0.63	0.93	3.71	44	0.60
960215	1634	1.35	0.083	12.0	68	92	0.59	0.40	3.53	49	0.18
960215	1934	1.39	0.054	18.5	66	89	0.60	0.67	3.50	50	0.79
960215	2235	1.44	0.054	18.5	66	96	0.66	0.23	2.73	61	-0.17
960216	0135	1.81	0.054	18.5	70	102	0.66	0.27	2.20	65	0.07
960216	0435	1.80	0.064	15.6	64	108	0.75	0.04	1.92	79	-0.27
960216	0735	1.75	0.064	15.6	66	104	0.74	0.09	1.92	79	0.09
960216	1058	1.67	0.064	15.6	60	102	0.76	0.16	1.93	81	0.22
960216	1334	1.69	0.064	15.6	64	101	0.74	0.38	1.99	76	0.61
960216	1634	1.79	0.064	15.6	60	99	0.74	0.40	2.05	74	0.35
960216	1932	1.88	0.064	15.6	68	101	0.68	0.30	2.40	66	0.29
960216	2232	1.99	0.064	15.6	68	102	0.67	0.28	2.20	69	0.42
960217	0134	1.94	0.064	15.6	66	102	0.69	0.40	2.18	68	0.40
960217	0434	1.93	0.064	15.6	68	100	0.66	0.49	2.60	57	0.15
960217	0734	2.11	0.074	13.6	80	99	0.58	0.30	3.26	43	0.04
960217	1034	2.21	0.064	15.6	82	95	0.49	0.48	4.68	32	0.54
960217	1331	2.13	0.074	13.6	82	96	0.49	0.43	4.82	32	0.36
960217	1637	2.25	0.074	13.6	86	94	0.47	0.74	5.53	26	0.56
960217	1934	2.51	0.074	13.6	88	93	0.44	0.45	6.13	23	0.28
960217	2234	3.25	0.064	15.6	90	91	0.40	-0.02	7.62	20	0.06
960218	0135	4.10	0.064	15.6	88	89	0.33	0.21	11.47	13	-0.01
960218	0434	3.85	0.074	13.6	84	87	0.37	0.46	10.13	17	0.13
960218	0735	3.63	0.074	13.6	82	86	0.37	0.36	9.14	18	0.21
960218	1335	3.25	0.074	13.6	92	88	0.42	-0.26	6.73	22	-0.20
960218	1635	3.03	0.074	13.6	92	88	0.44	-0.17	5.99	26	-0.17
960218	1935	2.99	0.074	13.6	88	88	0.47	-0.06	4.90	31	-0.06
960218	2235	3.07	0.083	12.0	100	86	0.46	0.02	4.93	33	-0.10
960219	0134	2.76	0.083	12.0	76	83	0.46	0.39	5.63	29	0.33
960219	0434	2.56	0.083	12.0	80	82	0.49	0.66	5.77	29	0.20
960219	1034	2.74	0.074	13.6	66	76	0.49	0.48	4.94	36	0.19
960219	1332	2.53	0.074	13.6	66	78	0.52	0.85	5.02	34	0.44
960219	1634	2.26	0.074	13.6	68	84	0.52	0.67	4.67	37	0.28

(Sheet 2 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960219	1935	2.39	0.074	13.6	74	86	0.54	0.35	4.47	38	0.24
960219	2235	2.80	0.083	12.0	64	82	0.49	0.35	4.56	37	0.03
960220	0134	2.79	0.083	12.0	74	83	0.50	0.35	4.02	41	0.17
960220	0434	2.62	0.093	10.7	66	84	0.55	0.47	4.03	43	0.32
960220	0734	2.31	0.074	13.6	64	85	0.57	0.73	4.14	43	0.39
960220	1034	2.46	0.074	13.6	72	82	0.52	0.59	4.57	38	0.07
960220	1335	2.23	0.083	12.0	60	79	0.55	0.96	4.66	38	0.22
960220	1657	2.32	0.083	12.0	66	80	0.53	0.79	4.76	36	0.25
960220	1934	2.83	0.093	10.7	64	74	0.51	0.75	4.79	34	0.31
960220	2235	3.29	0.083	12.0	62	73	0.48	1.02	5.56	32	0.64
960221	0134	3.29	0.083	12.0	60	74	0.47	0.76	5.30	33	0.18
960221	0434	2.72	0.083	12.0	72	78	0.49	1.00	6.03	29	0.15
960221	0735	2.32	0.083	12.0	72	79	0.54	1.39	5.78	28	0.32
960221	1035	2.41	0.083	12.0	62	74	0.52	1.24	5.73	33	0.34
960221	1335	2.88	0.093	10.7	64	71	0.45	1.11	6.54	24	0.33
960221	1723	3.06	0.093	10.7	64	70	0.47	0.89	6.20	29	0.23
960221	1935	2.80	0.093	10.7	76	74	0.53	0.65	5.13	34	-0.14
960222	0135	3.17	0.083	12.0	68	73	0.47	0.47	5.49	29	0.19
960222	0435	3.83	0.083	12.0	64	66	0.43	0.93	6.88	26	0.08
960222	1933	3.29	0.064	15.6	60	61	0.46	0.62	7.02	22	0.18
960222	2236	3.26	0.064	15.6	58	60	0.44	0.76	7.45	20	0.15
960223	0135	3.41	0.064	15.6	58	60	0.45	0.96	7.89	20	0.19
960223	0436	3.52	0.074	13.6	54	59	0.45	0.84	6.23	26	0.42
960223	0735	3.55	0.074	13.6	54	56	0.42	0.90	8.40	20	0.12
960223	1036	3.12	0.074	13.6	54	53	0.48	0.93	7.17	30	0.07
960223	1336	2.80	0.074	13.6	54	55	0.50	0.88	6.61	29	0.05
960223	1635	2.56	0.083	12.0	44	54	0.54	1.15	5.95	34	0.50
960223	1935	2.50	0.074	13.6	50	56	0.50	0.74	6.11	35	0.21
960223	2235	2.66	0.083	12.0	54	55	0.54	0.55	5.55	30	0.10
960224	0135	2.79	0.083	12.0	52	55	0.54	0.75	5.28	32	0.13
960224	0435	2.62	0.083	12.0	52	57	0.53	0.76	5.55	33	0.18
960224	0735	2.35	0.083	12.0	46	54	0.54	1.12	5.51	34	0.37
960224	1034	2.22	0.083	12.0	32	50	0.56	1.18	6.04	37	0.26
960224	1333	2.46	0.083	12.0	30	47	0.56	0.97	5.18	41	0.47
960224	1635	3.11	0.074	13.6	42	47	0.50	1.00	5.92	28	0.38
960224	1935	3.58	0.074	13.6	50	47	0.46	0.72	6.52	29	-0.11
960225	0135	3.56	0.064	15.6	54	53	0.46	0.61	7.45	25	-0.21
960225	0735	4.04	0.074	13.6	52	52	0.40	0.80	9.33	18	0.00
960225	1333	3.46	0.083	12.0	58	56	0.47	0.48	7.27	26	-0.27
960225	1636	3.61	0.083	12.0	54	56	0.48	0.48	6.28	29	0.05
960225	1936	3.63	0.064	15.6	54	55	0.46	0.42	6.81	25	-0.01
960225	2243	3.82	0.064	15.6	52	55	0.45	0.75	7.50	21	0.17
960226	0136	3.69	0.074	13.6	52	58	0.46	0.79	6.64	24	0.31
960226	0435	3.74	0.074	13.6	50	56	0.46	0.91	6.77	24	0.37
960226	0736	3.62	0.074	13.6	50	55	0.45	0.75	6.80	25	0.34
960226	1055	3.33	0.074	13.6	50	55	0.46	0.80	6.45	25	0.40
960226	1635	3.39	0.083	12.0	50	57	0.49	0.48	5.25	31	0.30
960226	1938	3.37	0.074	13.6	30	54	0.51	0.33	4.45	42	0.06
960226	2238	3.31	0.083	12.0	72	54	0.50	0.32	5.19	39	-0.18
960227	0138	3.13	0.083	12.0	54	56	0.48	0.55	6.68	24	0.13
960227	0438	2.92	0.083	12.0	50	54	0.49	0.87	6.64	26	0.16
960227	0739	2.64	0.093	10.7	56	52	0.50	0.70	6.64	31	-0.12

(Sheet 3 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960227	1101	2.48	0.083	12.0	48	52	0.49	0.89	7.66	26	0.19
960227	1338	2.44	0.093	10.7	50	54	0.49	1.25	7.24	24	0.21
960227	1638	2.48	0.093	10.7	30	53	0.55	0.59	4.41	47	0.50
960227	1938	2.37	0.093	10.7	28	52	0.59	0.66	4.47	46	0.20
960227	2238	2.19	0.093	10.7	46	59	0.53	0.91	5.40	32	0.26
960228	0138	2.10	0.093	10.7	40	57	0.54	0.96	5.61	35	0.21
960228	1139	2.66	0.064	15.6	62	57	0.47	0.77	7.05	27	-0.42
960228	1338	2.90	0.083	12.0	46	55	0.45	1.13	6.97	25	0.41
960228	1638	2.72	0.093	10.7	48	56	0.47	1.39	7.69	24	0.35
960228	1938	2.36	0.064	15.6	46	58	0.50	1.32	6.51	28	0.56
960228	2238	2.26	0.074	13.6	52	58	0.48	1.12	7.72	25	0.35
960229	0138	2.05	0.074	13.6	50	59	0.51	1.41	6.91	27	0.20
960229	0438	1.95	0.074	13.6	54	60	0.50	1.47	6.93	26	0.27
960229	0738	1.81	0.074	13.6	68	64	0.56	1.38	6.59	29	-0.12
960229	1338	1.75	0.093	10.7	68	62	0.63	1.11	5.63	34	-0.04
960229	1938	1.88	0.093	10.7	56	70	0.57	1.22	4.81	31	0.32
960229	2238	1.90	0.054	18.5	56	72	0.55	0.70	4.61	36	0.14
960301	0438	2.25	0.054	18.5	50	66	0.50	1.03	5.90	33	0.29
960301	0738	2.05	0.054	18.5	54	70	0.53	0.85	5.22	36	0.28
960301	1038	2.02	0.054	18.5	76	72	0.59	0.70	4.56	41	-0.14
960301	1338	1.72	0.064	15.6	84	74	0.58	0.42	4.48	39	-0.48
960301	1938	1.47	0.064	15.6	78	78	0.59	0.79	4.71	29	-0.19
960301	2238	1.48	0.064	15.6	82	81	0.54	0.37	4.68	29	-0.21
960302	0138	1.29	0.064	15.6	86	84	0.61	0.43	4.04	36	-0.13
960302	0438	1.13	0.064	15.6	90	84	0.63	0.34	3.62	43	-0.38
960302	0738	1.03	0.064	15.6	84	86	0.65	0.75	3.85	34	-0.05
960302	1038	1.00	0.064	15.6	88	94	0.60	0.56	4.47	31	0.20
960302	1338	1.02	0.064	15.6	88	100	0.61	0.42	3.78	39	0.55
960302	1638	1.09	0.074	13.6	116	103	0.54	-0.05	4.46	37	-0.06
960302	1938	1.22	0.074	13.6	124	107	0.51	-0.06	4.86	37	-0.18
960302	2238	1.29	0.074	13.6	124	109	0.51	-0.26	4.66	38	-0.66
960303	0138	1.36	0.074	13.6	126	109	0.51	-0.11	4.60	39	-0.29
960303	0438	1.55	0.074	13.6	94	106	0.46	0.44	5.55	33	0.61
960303	0738	1.81	0.074	13.6	86	100	0.48	0.58	5.27	35	0.91
960303	1038	2.19	0.083	12.0	96	101	0.39	0.37	7.80	21	0.35
960303	1338	2.21	0.083	12.0	96	98	0.43	0.17	6.46	24	0.18
960303	1637	2.02	0.093	10.7	88	96	0.45	0.49	5.94	26	0.25
960303	1936	1.86	0.083	12.0	88	98	0.48	0.58	4.84	32	0.55
960303	2247	1.81	0.093	10.7	92	99	0.50	0.30	5.07	32	0.22
960304	0138	1.71	0.083	12.0	94	99	0.49	0.36	5.25	31	0.16
960304	0438	1.55	0.083	12.0	78	95	0.55	0.36	4.41	38	0.23
960304	0736	1.61	0.093	10.7	80	96	0.59	0.31	3.80	43	0.31
960304	1056	1.75	0.054	18.5	70	90	0.60	0.61	4.14	43	0.49
960304	1339	1.92	0.054	18.5	76	86	0.49	0.73	5.31	29	0.77
960304	1634	2.18	0.054	18.5	74	81	0.44	1.48	7.31	16	0.81
960304	2237	2.17	0.054	18.5	72	81	0.50	1.04	6.27	23	0.70
960305	0138	2.31	0.054	18.5	72	80	0.49	1.08	5.85	26	0.63
960305	0438	2.70	0.093	10.7	72	77	0.44	0.90	7.05	22	0.32
960305	0737	3.02	0.093	10.7	72	76	0.43	0.61	6.58	23	0.20
960305	1009	3.43	0.083	12.0	72	77	0.44	0.65	6.68	23	0.31
960305	1331	4.06	0.083	12.0	72	77	0.41	0.48	7.08	21	0.37
960305	1652	3.92	0.083	12.0	70	75	0.42	0.44	5.33	27	0.21
960305	1723	3.88	0.083	12.0	72	76	0.46	0.42	5.94	29	0.26

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960305	1938	3.83	0.083	12.0	72	74	0.40	0.41	7.47	20	0.09
960305	2238	3.50	0.083	12.0	68	75	0.42	0.52	6.62	24	0.41
960306	0208	3.49	0.083	12.0	70	77	0.45	0.30	4.92	31	0.20
960306	0435	3.34	0.083	12.0	74	77	0.44	0.22	5.71	29	0.08
960306	0738	2.97	0.093	10.7	76	75	0.48	0.16	4.87	33	-0.03
960306	1115	3.00	0.093	10.7	70	75	0.47	0.24	4.75	35	0.12
960306	1333	2.95	0.093	10.7	58	72	0.49	0.45	4.82	35	0.20
960306	1732	2.80	0.093	10.7	44	68	0.52	0.39	4.34	42	0.02
960306	1938	2.37	0.093	10.7	72	67	0.55	0.46	4.55	41	-0.14
960306	2235	2.08	0.093	10.7	58	71	0.55	0.77	4.25	37	0.49
960307	0138	1.83	0.103	9.7	52	74	0.60	0.56	4.14	44	0.06
960307	0438	1.55	0.074	13.6	46	75	0.64	0.55	3.43	51	0.04
960307	0738	1.30	0.074	13.6	54	74	0.67	0.80	3.35	49	0.43
960307	0908	1.23	0.074	13.6	54	76	0.71	0.77	3.02	56	0.55
960307	1038	1.09	0.074	13.6	54	82	0.76	0.67	2.63	66	0.61
960307	1359	0.90	0.074	13.6	44	86	0.83	0.50	2.41	76	0.11
960307	1634	0.79	0.074	13.6	42	92	0.84	0.21	1.97	87	0.20
960307	1938	0.76	0.074	13.6	38	98	0.88	0.31	2.04	90	0.24
960308	0905	0.89	0.074	13.6	90	100	0.62	0.89	3.87	39	0.44
960308	1042	1.00	0.083	12.0	92	98	0.59	0.82	4.30	37	0.18
960308	1338	1.23	0.074	13.6	88	94	0.55	0.62	4.83	36	0.19
960308	1638	1.34	0.074	13.6	84	94	0.57	0.82	4.82	36	0.51
960308	1938	1.51	0.083	12.0	90	97	0.51	0.61	5.17	32	0.34
960308	2236	1.69	0.083	12.0	94	100	0.48	0.52	5.53	29	0.33
960309	0138	1.74	0.083	12.0	136	109	0.95	-0.14	2.14	88	-0.85
960309	0438	1.82	0.083	12.0	140	117	0.93	-0.41	2.26	84	-1.15
960309	0738	1.69	0.093	10.7	96	98	0.52	0.32	4.60	36	0.02
960309	1031	1.61	0.083	12.0	88	97	0.54	0.63	4.62	38	0.34
960309	1333	1.61	0.093	10.7	72	96	0.55	0.28	3.91	44	0.08
960309	1638	1.75	0.093	10.7	98	97	0.54	0.20	4.06	40	0.05
960310	0136	1.51	0.074	13.6	140	114	0.96	-0.40	2.16	89	-1.17
960310	0437	1.57	0.074	13.6	116	104	0.56	0.06	4.15	41	-0.18
960310	0736	1.57	0.074	13.6	154	119	1.11	-0.46	1.88	114	-0.77
960310	1803	1.80	0.074	13.6	140	116	0.95	-0.41	2.20	86	-1.03
960310	1931	1.83	0.074	13.6	140	117	0.96	-0.36	2.15	88	-1.05
960310	2231	2.02	0.074	13.6	84	96	0.49	0.58	5.22	32	0.27
960311	0124	2.22	0.074	13.6	136	104	1.06	-0.16	2.05	98	-0.31
960311	0433	2.61	0.083	12.0	140	104	0.98	-0.11	1.96	95	-0.81
960311	0733	2.67	0.083	12.0	84	89	0.45	0.33	5.56	28	0.19
960311	0805	2.65	0.083	12.0	148	103	1.22	-0.17	1.58	131	-0.82
960311	1106	2.43	0.083	12.0	78	92	0.48	0.44	4.68	36	0.29
960311	1338	2.20	0.083	12.0	86	91	0.53	0.30	4.51	35	0.13
960311	1934	2.03	0.083	12.0	92	92	0.56	0.09	4.40	36	-0.01
960311	2234	1.90	0.083	12.0	82	89	0.53	0.46	4.34	36	0.17
960312	0135	1.87	0.083	12.0	76	87	0.54	0.45	4.39	37	0.26
960312	0434	1.96	0.083	12.0	74	86	0.52	0.71	4.83	35	0.37
960312	1338	2.92	0.083	12.0	90	90	0.48	0.16	4.82	35	-0.04
960312	1635	3.69	0.113	8.9	108	90	0.48	-0.04	3.78	41	-0.21
960312	1713	3.90	0.103	9.7	108	90	0.48	-0.01	3.70	41	-0.12
960312	1940	4.68	0.093	10.7	74	85	0.44	0.25	4.32	33	0.18
960312	2238	4.13	0.083	12.0	76	84	0.43	0.25	4.88	31	0.24
960313	0138	3.93	0.093	10.7	82	85	0.64	1.00	5.78	26	0.12

(Sheet 5 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960313	0435	4.74	0.083	12.0	24	37	0.80	2.46	4.01	36	0.87
960313	0506	4.80	0.083	12.0	54	71	0.54	0.01	3.44	45	0.02
960313	1339	4.65	0.083	12.0	52	66	0.50	0.69	4.11	36	0.64
960313	1638	3.81	0.083	12.0	52	68	0.52	0.50	3.83	40	0.50
960313	1708	3.78	0.083	12.0	52	68	0.53	0.55	3.70	42	0.58
960313	1939	3.56	0.083	12.0	50	65	0.52	0.88	4.38	36	0.72
960313	2238	3.30	0.093	10.7	52	65	0.52	0.76	4.50	36	0.60
960314	0138	3.30	0.093	10.7	34	54	0.61	0.83	3.29	52	1.00
960314	0206	3.42	0.093	10.7	52	64	0.55	0.65	4.11	40	0.72
960314	0438	3.26	0.083	12.0	50	61	0.52	1.04	4.79	34	0.77
960314	1042	2.67	0.093	10.7	52	64	0.55	1.18	4.91	34	0.55
960314	1353	2.16	0.093	10.7	60	73	0.60	0.84	4.11	42	0.41
960314	1638	2.05	0.093	10.7	58	76	0.60	0.78	3.80	45	0.51
960314	1938	2.06	0.093	10.7	64	75	0.59	0.52	3.87	43	0.21
960314	2238	2.02	0.103	9.7	56	69	0.58	0.77	4.29	39	0.19
960315	0136	2.08	0.103	9.7	68	69	0.54	1.11	5.10	32	0.12
960315	0438	2.00	0.064	15.6	66	73	0.56	0.94	4.59	36	0.27
960315	0738	2.05	0.064	15.6	64	72	0.52	1.01	5.31	30	0.43
960315	1038	1.94	0.064	15.6	68	74	0.55	0.90	4.86	31	0.31
960315	1338	1.97	0.064	15.6	72	75	0.51	1.09	6.08	23	0.08
960315	1538	2.13	0.064	15.6	70	74	0.49	1.30	6.76	20	0.12
960315	1936	2.28	0.064	15.6	68	73	0.51	0.91	5.25	27	0.44
960315	2238	2.52	0.074	13.6	70	71	0.49	0.29	5.24	28	0.11
960316	0135	2.62	0.074	13.6	70	68	0.48	0.32	6.03	25	-0.09
960316	0438	2.60	0.074	13.6	72	69	0.51	0.26	5.04	30	-0.16
960316	0738	2.31	0.074	13.6	68	67	0.53	0.25	4.48	34	-0.06
960316	1036	2.60	0.074	13.6	76	67	0.53	-0.05	3.85	38	-0.16
960316	1336	2.57	0.074	13.6	76	65	0.54	0.05	3.85	41	-0.39
960316	1635	2.42	0.074	13.6	68	62	0.52	0.24	4.31	36	-0.22
960316	1934	2.29	0.074	13.6	58	64	0.58	0.37	3.73	41	0.13
960316	2235	2.38	0.083	12.0	66	64	0.54	0.20	4.25	36	-0.03
960317	0138	2.29	0.074	13.6	66	63	0.50	0.34	4.65	34	-0.13
960317	0438	2.07	0.083	12.0	64	65	0.55	0.48	4.40	37	0.00
960317	0733	1.95	0.083	12.0	60	65	0.55	0.54	4.26	37	0.15
960317	1038	1.83	0.083	12.0	50	63	0.58	0.64	4.05	41	0.17
960317	1336	1.69	0.093	10.7	58	60	0.58	0.55	4.44	38	0.05
960317	1635	1.73	0.093	10.7	48	60	0.58	0.74	4.34	40	0.24
960317	1938	1.55	0.083	12.0	50	64	0.60	0.72	3.95	40	0.32
960317	2236	1.70	0.093	10.7	64	61	0.59	0.44	3.71	46	-0.02
960318	0134	1.92	0.093	10.7	84	64	0.56	0.42	3.99	44	-0.10
960318	0436	1.99	0.054	18.5	78	64	0.58	0.71	4.65	40	-0.26
960318	0736	1.91	0.054	18.5	80	70	0.54	0.58	5.14	35	-0.63
960318	1037	1.95	0.054	18.5	82	75	0.51	0.22	5.58	28	-0.60
960318	1210	2.04	0.054	18.5	82	73	0.50	0.01	5.70	27	-0.68
960318	1335	2.13	0.054	18.5	80	73	0.49	0.17	6.00	26	-0.65
960318	1635	2.08	0.054	18.5	76	69	0.50	0.59	5.81	28	-0.52
960318	1931	2.01	0.054	18.5	82	74	0.54	0.42	5.04	30	-0.54
960318	2232	2.14	0.064	15.6	78	75	0.48	0.44	6.60	23	-0.14
960319	0135	2.40	0.064	15.6	78	75	0.41	0.21	7.84	19	-0.18
960319	0435	2.33	0.064	15.6	78	75	0.45	0.29	7.43	19	-0.25
960319	0735	2.07	0.064	15.6	72	73	0.45	0.72	7.32	21	0.02
960319	1035	2.16	0.064	15.6	76	74	0.45	0.30	6.73	24	-0.05
960319	1333	2.11	0.064	15.6	80	75	0.46	0.05	5.96	27	-0.11
960319	2235	2.27	0.064	15.6	70	71	0.47	0.52	6.60	23	0.05

(Sheet 6 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	A
960320	0135	2.48	0.074	13.6	68	67	0.47	0.58	6.16	26	-0.07
960320	0435	2.77	0.064	15.6	66	61	0.43	0.61	7.01	25	-0.35
960320	0733	2.88	0.064	15.6	66	63	0.43	0.53	7.90	21	-0.24
960320	1035	3.03	0.074	13.6	60	64	0.48	0.87	6.09	24	0.23
960320	1407	3.46	0.074	13.6	62	61	0.41	0.54	7.11	22	-0.04
960320	1635	3.44	0.074	13.6	62	60	0.43	0.62	7.99	20	-0.14
960320	1935	3.02	0.074	13.6	62	63	0.47	0.49	6.96	21	-0.04
960320	2235	2.88	0.083	12.0	58	61	0.47	1.34	6.62	22	0.21
960321	0136	2.91	0.083	12.0	56	61	0.48	1.25	6.36	23	0.19
960321	0435	3.24	0.074	13.6	54	58	0.46	1.66	7.56	19	0.15
960321	0735	2.81	0.074	13.6	56	60	0.49	1.26	6.54	24	0.19
960321	1035	2.82	0.074	13.6	54	61	0.52	1.42	5.80	25	0.37
960321	1335	2.88	0.083	12.0	56	60	0.54	1.30	5.30	28	0.23
960321	1637	2.79	0.083	12.0	50	57	0.56	1.29	5.02	32	0.25
960321	2236	2.26	0.083	12.0	60	66	0.60	1.20	4.67	31	0.28
960322	0135	2.43	0.054	18.5	54	64	0.60	0.93	4.18	35	0.21
960322	0436	2.71	0.054	18.5	46	59	0.54	1.19	5.11	33	0.34
960322	1229	2.48	0.054	18.5	78	68	0.56	0.95	4.59	32	-0.02
960322	1637	2.73	0.064	15.6	52	59	0.60	0.69	3.97	42	0.02
960322	2236	2.87	0.132	7.6	54	45	0.61	0.74	3.88	46	-0.03
960323	0136	3.12	0.132	7.6	24	47	0.58	0.91	4.19	43	0.08
960323	0436	2.77	0.123	8.2	46	56	0.57	0.97	4.23	40	0.17
960323	0732	2.42	0.123	8.2	46	58	0.56	1.33	4.99	35	0.25
960323	1035	2.32	0.132	7.6	54	57	0.64	1.08	4.03	42	-0.08
960323	1358	2.32	0.064	15.6	56	62	0.63	1.06	4.05	41	0.06
960323	1636	2.43	0.123	8.2	48	60	0.64	1.33	4.21	38	0.24
960323	1936	2.25	0.123	8.2	50	60	0.70	1.76	4.06	36	0.30
960323	2229	1.89	0.064	15.6	48	65	0.81	1.59	3.18	46	0.34
960324	0133	1.75	0.064	15.6	54	74	0.83	1.48	2.81	58	0.92
960324	0431	1.93	0.074	13.6	52	69	0.75	2.00	3.61	39	0.83
960324	0850	1.76	0.074	13.6	48	70	0.81	2.02	3.15	50	1.01
960324	1633	1.67	0.064	15.6	38	75	0.94	1.26	2.11	112	1.44
960324	1936	1.62	0.064	15.6	46	77	0.98	1.25	2.02	116	1.54
960324	2236	1.41	0.064	15.6	170	93	1.04	0.41	1.47	123	0.97
960325	0436	1.20	0.064	15.6	168	121	1.01	-0.61	1.66	116	-1.11
960325	0736	1.34	0.064	15.6	170	101	1.04	0.15	1.35	125	0.71
960325	1034	1.16	0.064	15.6	172	109	1.07	-0.08	1.36	125	0.06
960325	1938	1.45	0.162	6.2	54	76	0.97	0.79	1.99	108	0.76
960325	2237	1.95	0.152	6.6	12	49	0.86	1.48	3.03	64	0.28
960326	0137	1.92	0.132	7.6	14	50	0.89	1.65	2.83	67	0.45
960326	1035	1.65	0.142	7.0	62	72	0.86	1.04	2.51	71	0.41
960326	1637	1.48	0.064	15.6	80	100	0.83	0.15	2.10	80	0.48
960326	1936	1.61	0.064	15.6	76	100	0.76	0.59	2.39	69	0.84
960326	2236	1.65	0.074	13.6	76	101	0.73	0.67	2.58	62	0.69
960327	0135	1.80	0.074	13.6	82	101	0.65	0.89	3.07	46	0.60
960327	0436	1.79	0.074	13.6	82	96	0.61	0.85	3.90	39	0.30
960327	0736	1.81	0.074	13.6	78	92	0.60	0.91	3.89	38	0.40
960327	1036	1.82	0.074	13.6	78	93	0.60	1.28	4.16	35	0.48
960327	1333	1.82	0.074	13.6	76	93	0.63	1.00	3.47	43	0.63
960327	1638	1.65	0.074	13.6	34	49	0.84	1.25	3.24	56	0.85
960327	1935	1.61	0.074	13.6	78	96	0.63	0.59	3.47	45	0.32
960327	2234	1.64	0.074	13.6	70	90	0.77	0.17	2.73	63	0.05

(Sheet 7 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960328	1036	1.60	0.083	12.0	76	88	0.60	0.94	4.08	36	0.41
960328	1335	1.55	0.083	12.0	72	87	0.60	0.92	4.14	37	0.37
960328	1635	1.53	0.054	18.5	70	89	0.62	0.80	4.00	41	0.39
960328	1936	1.96	0.162	6.2	92	73	0.66	0.12	3.05	52	-0.08
960328	2236	2.94	0.132	7.6	34	53	0.60	0.56	3.44	48	0.35
960329	0438	2.13	0.132	7.6	60	67	0.58	0.23	3.55	45	0.04
960329	0736	2.02	0.064	15.6	62	73	0.55	0.37	4.05	40	0.19
960329	1036	1.90	0.064	15.6	60	71	0.57	0.64	3.76	43	0.27
960329	1336	1.75	0.064	15.6	58	68	0.56	0.67	3.94	40	0.37
960329	1634	1.62	0.064	15.6	66	72	0.61	0.56	3.69	43	0.16
960329	1934	1.52	0.064	15.6	64	78	0.58	0.63	3.93	40	0.24
960329	2236	1.53	0.083	12.0	68	76	0.55	0.75	4.65	33	0.24
960330	0136	1.59	0.093	10.7	68	79	0.56	0.86	4.49	34	0.35
960330	0755	1.46	0.093	10.7	68	80	0.58	0.66	3.90	40	0.25
960330	1031	1.32	0.093	10.7	66	81	0.61	0.75	3.48	44	0.40
960330	1331	1.15	0.093	10.7	70	82	0.62	0.84	3.67	42	0.39
960330	1936	1.00	0.074	13.6	66	87	0.69	0.70	3.15	50	0.36
960330	2236	0.76	0.074	13.6	74	90	0.69	0.68	3.19	49	0.40
960331	0436	0.88	0.074	13.6	74	96	0.76	0.70	2.56	63	0.72
960331	0736	0.88	0.074	13.6	76	99	0.74	0.56	2.56	64	0.61
960331	1032	0.90	0.074	13.6	82	101	0.76	0.40	2.35	71	0.58
960331	1334	0.88	0.074	13.6	76	105	0.77	0.41	2.20	79	0.84
960331	1635	0.87	0.083	12.0	80	103	0.77	0.59	2.47	70	0.88
960331	1934	0.85	0.064	15.6	162	114	0.78	0.03	2.06	80	0.34
960331	2234	0.87	0.064	15.6	76	110	0.80	0.20	1.95	84	0.63
960401	0134	0.85	0.083	12.0	76	116	0.81	0.11	2.03	83	0.36
960401	0427	0.85	0.074	13.6	80	119	0.78	0.11	2.17	78	0.25
960401	0851	0.85	0.074	13.6	166	123	0.80	-0.13	2.05	82	-0.17
960401	1332	0.83	0.074	13.6	162	119	0.73	0.01	2.22	73	0.22
960401	1635	0.81	0.074	13.6	78	118	0.83	0.19	2.17	83	0.30
960401	1934	0.84	0.074	13.6	80	115	0.80	0.23	2.40	76	0.32
960401	2234	0.90	0.074	13.6	72	112	0.76	0.04	2.39	72	-0.08
960402	0134	1.04	0.074	13.6	120	112	0.73	-0.07	2.48	67	-0.06
960402	0429	1.17	0.142	7.0	106	104	0.66	0.20	3.15	47	-0.01
960402	0849	1.34	0.132	7.6	100	94	0.58	0.38	3.82	38	-0.11
960402	1035	1.51	0.132	7.6	98	93	0.55	0.48	4.29	34	-0.09
960402	1334	1.86	0.123	8.2	98	95	0.52	0.41	4.83	30	-0.11
960402	1632	2.32	0.103	9.7	96	93	0.46	0.02	5.48	27	-0.16
960402	1935	2.83	0.093	10.7	94	93	0.45	-0.31	5.26	28	-0.06
960402	2230	2.98	0.083	12.0	102	93	0.47	-0.64	4.86	30	-0.31
960403	0858	2.71	0.083	12.0	92	81	0.53	-0.28	3.66	39	-0.46
960403	0956	2.65	0.083	12.0	94	80	0.54	-0.13	3.36	44	-0.34
960403	1123	2.56	0.083	12.0	92	79	0.55	-0.17	3.34	44	-0.37
960403	1314	2.56	0.093	10.7	86	80	0.53	-0.22	3.94	38	-0.20
960403	1632	2.53	0.093	10.7	96	73	0.56	0.02	3.43	47	-0.20
960403	1935	2.58	0.152	6.6	72	70	0.58	-0.02	3.37	46	-0.31
960403	2230	2.70	0.142	7.0	74	70	0.59	0.03	3.26	44	-0.30
960404	1026	1.91	0.064	15.6	46	73	0.63	0.29	3.15	53	0.00
960404	1138	1.94	0.064	15.6	52	72	0.60	0.27	3.26	50	0.09
960404	1408	1.94	0.064	15.6	92	74	0.58	0.24	3.65	45	-0.10
960404	1639	2.01	0.064	15.6	90	75	0.58	0.02	3.86	43	-0.39
960404	1814	2.01	0.064	15.6	68	73	0.58	0.33	3.78	41	0.10
960404	1937	1.91	0.064	15.6	70	70	0.62	0.49	3.77	42	-0.06

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960404	2237	1.80	0.064	15.6	76	71	0.62	0.35	3.83	41	-0.30
960405	0133	1.68	0.064	15.6	78	71	0.62	0.09	3.49	48	-0.28
960405	0431	1.91	0.064	15.6	82	71	0.61	0.21	3.51	45	-0.22
960405	0856	1.61	0.064	15.6	70	73	0.56	0.46	4.11	36	0.02
960405	1037	1.69	0.074	13.6	52	72	0.58	0.47	3.86	44	-0.03
960405	1233	1.53	0.074	13.6	44	71	0.62	0.51	3.56	48	-0.01
960405	1503	1.65	0.074	13.6	76	67	0.59	0.29	3.98	42	-0.41
960405	1648	1.68	0.132	7.6	66	65	0.58	0.31	3.82	40	-0.07
960405	1809	1.59	0.074	13.6	74	66	0.60	0.43	3.91	42	-0.20
960405	1939	1.59	0.074	13.6	66	67	0.62	0.71	4.03	40	-0.07
960405	2107	1.60	0.074	13.6	66	69	0.60	0.68	4.27	33	0.01
960406	0004	1.58	0.074	13.6	70	75	0.62	0.26	4.11	35	0.30
960406	0136	1.63	0.074	13.6	66	72	0.58	0.59	4.11	38	0.17
960406	0307	1.77	0.074	13.6	70	70	0.53	0.63	4.91	34	-0.06
960406	0957	2.07	0.074	13.6	62	66	0.47	0.96	6.59	23	0.15
960406	1207	2.28	0.074	13.6	62	64	0.45	0.77	6.44	23	0.09
960406	1337	2.63	0.074	13.6	66	66	0.43	0.53	6.78	24	-0.01
960406	1504	2.92	0.074	13.6	68	68	0.41	0.66	7.65	20	0.01
960406	1639	2.76	0.074	13.6	70	69	0.40	0.40	9.50	16	-0.01
960406	2006	2.55	0.074	13.6	70	70	0.41	0.65	9.03	16	0.00
960406	2237	2.38	0.074	13.6	68	70	0.45	0.63	7.57	20	0.09
960407	0137	2.66	0.074	13.6	66	72	0.42	0.59	7.10	24	0.25
960407	0437	2.82	0.074	13.6	68	71	0.45	0.51	7.26	24	0.24
960407	0803	2.76	0.074	13.6	66	68	0.42	0.98	9.04	19	0.11
960407	1036	2.24	0.074	13.6	66	70	0.47	0.84	6.85	24	0.15
960407	1337	2.21	0.074	13.6	70	75	0.48	0.49	5.82	27	0.19
960407	1824	2.13	0.083	12.0	70	75	0.51	0.64	5.36	31	0.11
960407	1937	2.04	0.083	12.0	72	75	0.53	0.60	5.02	33	0.13
960407	2237	1.82	0.083	12.0	80	75	0.55	0.72	4.90	34	-0.20
960408	0136	1.77	0.083	12.0	64	75	0.56	0.72	4.56	35	0.32
960408	0209	1.77	0.083	12.0	60	75	0.56	0.91	5.34	35	0.27
960408	0436	1.86	0.083	12.0	58	73	0.56	0.93	4.67	38	0.34
960408	0738	1.78	0.093	10.7	56	68	0.56	1.37	5.16	33	0.52
960408	1122	1.42	0.083	12.0	54	79	0.69	0.73	3.04	54	0.39
960408	1405	1.45	0.083	12.0	68	80	0.65	0.77	3.59	42	0.35
960408	1704	1.35	0.093	10.7	64	82	0.69	0.79	3.11	49	0.32
960408	1943	1.35	0.083	12.0	64	85	0.70	0.88	3.23	48	0.33
960408	2243	1.28	0.083	12.0	68	91	0.70	0.75	3.01	50	0.24
960409	0141	1.41	0.074	13.6	62	85	0.72	0.95	2.97	51	0.35
960409	0443	1.49	0.083	12.0	52	81	0.73	1.05	2.90	56	0.60
960409	0743	1.37	0.083	12.0	56	85	0.78	0.97	2.67	60	0.57
960409	1043	1.33	0.083	12.0	50	84	0.76	0.94	2.63	62	0.40
960409	1343	1.43	0.083	12.0	50	83	0.77	1.03	2.75	58	0.31
960409	1642	1.55	0.083	12.0	46	82	0.84	0.81	2.14	83	0.89
960409	1939	1.45	0.083	12.0	50	84	0.85	0.83	2.25	83	0.85
960409	2246	1.43	0.083	12.0	52	88	0.83	0.82	2.39	74	0.40
960410	0145	2.25	0.152	6.6	88	76	0.69	0.53	3.25	52	-0.40
960410	0446	2.86	0.132	7.6	38	68	0.67	0.80	3.24	49	-0.07
960410	0746	2.98	0.132	7.6	48	62	0.64	1.01	3.75	46	0.21
960410	1346	2.95	0.132	7.6	40	64	0.59	1.04	4.30	41	-0.01
960410	1643	3.50	0.123	8.2	34	57	0.57	0.92	4.36	41	-0.02
960410	1946	3.29	0.123	8.2	30	54	0.58	0.81	4.30	44	-0.02
960410	2244	3.28	0.123	8.2	30	54	0.61	1.01	4.34	46	0.11

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960411	0145	2.56	0.123	8.2	36	59	0.67	1.46	4.10	47	0.45
960411	0446	2.04	0.132	7.6	44	68	0.75	1.43	3.33	53	0.71
960411	0745	1.67	0.152	6.6	42	73	0.80	1.22	2.81	61	0.39
960411	1046	1.72	0.152	6.6	40	74	0.79	1.13	2.76	62	0.23
960411	1347	1.82	0.142	7.0	42	78	0.74	0.76	2.88	59	-0.22
960411	1645	1.88	0.162	6.2	34	67	0.77	0.84	2.82	63	0.13
960411	1946	2.10	0.142	7.0	34	59	0.71	1.06	3.52	53	0.16
960411	2245	1.87	0.142	7.0	36	63	0.74	1.27	3.38	52	0.18
960412	0146	1.85	0.142	7.0	36	62	0.74	1.48	3.43	53	0.76
960412	0446	1.93	0.142	7.0	34	59	0.72	1.28	3.54	51	0.41
960412	0743	1.76	0.142	7.0	40	63	0.74	1.47	3.67	50	0.48
960412	1044	1.75	0.142	7.0	40	66	0.69	0.92	3.53	53	0.32
960412	1346	1.99	0.152	6.6	70	61	0.65	0.83	3.93	47	-0.13
960412	1642	2.88	0.132	7.6	70	52	0.58	0.55	3.90	47	-0.25
960412	1944	3.23	0.132	7.6	62	46	0.54	0.57	4.38	42	-0.26
960412	2244	3.18	0.064	15.6	60	50	0.51	0.49	5.34	35	-0.44
960413	0144	3.44	0.074	13.6	60	53	0.47	0.64	6.60	27	-0.37
960413	1725	2.24	0.083	12.0	58	62	0.54	0.93	6.28	27	0.00
960413	1941	1.99	0.083	12.0	64	60	0.57	0.99	5.51	32	-0.12
960413	2244	2.29	0.074	13.6	60	62	0.49	1.14	6.99	21	0.03
960414	0144	2.37	0.074	13.6	62	63	0.47	0.97	6.89	23	-0.05
960414	0444	2.10	0.083	12.0	64	63	0.55	0.98	5.77	30	-0.07
960414	0744	1.90	0.083	12.0	64	67	0.55	1.24	5.87	27	0.08
960414	1046	1.81	0.083	12.0	56	71	0.60	1.06	4.45	37	0.31
960414	1343	1.58	0.083	12.0	50	67	0.61	0.93	4.56	40	0.22
960414	1646	1.43	0.083	12.0	46	70	0.67	0.88	3.84	47	-0.03
960414	1945	1.36	0.083	12.0	54	75	0.65	0.59	3.49	50	0.18
960414	2246	1.27	0.083	12.0	70	77	0.65	0.86	4.07	40	0.24
960415	0146	1.33	0.083	12.0	70	75	0.63	1.34	4.68	28	0.17
960415	0446	1.72	0.083	12.0	70	74	0.50	2.34	7.96	15	0.10
960415	0746	2.32	0.074	13.6	68	71	0.42	2.11	11.72	11	0.08
960415	1046	3.36	0.064	15.6	74	74	0.36	1.00	14.08	10	0.00
960415	1346	3.18	0.064	15.6	72	75	0.40	1.05	10.73	13	0.17
960415	1645	3.36	0.064	15.6	72	75	0.38	1.34	12.22	11	0.20
960416	0720	2.81	0.074	13.6	70	75	0.45	1.06	7.86	18	0.38
960416	0957	2.67	0.074	13.6	68	73	0.46	1.14	8.07	16	0.39
960416	1345	2.58	0.074	13.6	70	74	0.48	0.80	6.35	25	0.24
960416	1645	2.43	0.074	13.6	72	75	0.48	0.47	6.91	21	0.31
960416	1946	2.34	0.074	13.6	74	74	0.50	0.30	6.27	22	0.08
960416	2245	2.28	0.074	13.6	70	74	0.47	0.68	7.02	19	0.31
960417	0146	2.54	0.074	13.6	68	72	0.48	0.54	6.91	24	0.32
960417	0446	3.59	0.074	13.6	70	71	0.38	0.15	10.04	13	0.22
960417	1059	4.07	0.064	15.6	70	67	0.38	0.17	10.13	13	-0.30
960417	1344	3.85	0.064	15.6	68	67	0.40	0.40	9.02	16	-0.18
960417	1645	3.46	0.064	15.6	70	69	0.43	0.25	8.89	15	-0.11
960417	1946	2.72	0.064	15.6	68	69	0.47	0.79	8.11	15	0.22
960417	2245	2.95	0.074	13.6	64	69	0.43	1.16	9.24	12	0.40
960418	0144	2.95	0.074	13.6	64	70	0.40	1.20	9.66	14	0.40
960418	0444	3.30	0.074	13.6	66	71	0.43	0.59	6.95	22	0.45
960418	0747	3.40	0.074	13.6	64	66	0.51	0.29	5.00	27	0.19
960418	0950	3.12	0.074	13.6	62	66	0.49	0.80	5.36	26	0.22
960419	1000	2.78	0.074	13.6	66	68	0.63	0.33	4.56	33	0.22

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960419	1333	3.03	0.074	13.6	60	60	0.47	0.72	6.34	23	-0.10
960419	1635	3.47	0.083	12.0	84	79	0.51	-0.95	6.37	18	-0.37
960419	1933	3.12	0.074	13.6	64	68	0.72	-0.02	3.74	40	0.38
960419	2235	2.90	0.074	13.6	56	55	1.01	0.20	2.42	78	-0.26
960420	0733	2.75	0.074	13.6	58	61	0.73	0.18	3.30	47	0.12
960420	1034	2.98	0.074	13.6	48	51	0.80	0.84	3.59	38	-0.02
960420	1634	3.61	0.083	12.0	84	68	0.69	-0.16	3.43	52	-0.21
960420	1935	3.28	0.083	12.0	64	59	0.65	-0.04	4.81	37	-0.28
960420	2235	3.16	0.083	12.0	86	81	0.63	-0.79	4.44	30	-0.11
960421	0135	3.06	0.074	13.6	62	58	0.48	0.63	5.97	29	-0.16
960421	0433	2.95	0.074	13.6	58	61	0.77	0.56	3.72	39	0.20
960421	0734	2.99	0.083	12.0	64	68	0.75	0.33	3.84	43	0.26
960421	1034	3.15	0.074	13.6	58	59	0.55	0.96	6.22	21	0.03
960421	1335	3.18	0.074	13.6	86	81	0.52	-0.72	5.76	24	-0.15
960421	1635	3.03	0.083	12.0	48	55	0.67	0.92	4.51	31	0.30
960421	1935	2.56	0.074	13.6	58	65	0.82	0.25	2.71	72	0.00
960421	2234	2.04	0.083	12.0	56	64	0.81	0.99	3.56	39	0.61
960422	0135	1.77	0.083	12.0	50	56	0.77	0.82	3.50	37	0.43
960422	0435	1.92	0.083	12.0	48	52	0.90	0.75	3.23	41	0.16
960422	0735	1.97	0.083	12.0	48	62	0.63	2.04	5.12	32	0.24
960422	1426	1.93	0.093	10.7	46	69	0.75	1.51	3.26	47	0.44
960422	1646	1.95	0.083	12.0	54	69	0.70	1.50	3.66	41	0.15
960422	1925	1.92	0.083	12.0	62	68	0.67	1.72	4.23	32	0.09
960423	0902	2.03	0.064	15.6	68	70	0.71	0.82	3.57	42	0.06
960423	1034	1.92	0.064	15.6	80	75	0.67	0.73	4.34	28	-0.45
960423	1518	1.71	0.074	13.6	64	74	0.61	1.65	4.69	28	0.46
960423	1636	1.75	0.074	13.6	62	76	0.66	1.49	3.92	35	0.61
960423	1936	2.00	0.074	13.6	66	72	0.55	1.71	5.82	24	0.28
960423	2236	2.00	0.083	12.0	62	68	0.57	1.91	5.45	24	0.26
960424	0137	2.04	0.083	12.0	64	70	0.53	1.82	6.27	22	0.21
960424	0436	2.23	0.093	10.7	64	68	0.59	1.53	5.08	26	0.13
960424	0737	2.33	0.093	10.7	64	66	0.54	1.05	5.42	26	0.02
960424	0850	2.33	0.064	15.6	64	65	0.54	0.91	5.34	28	0.01
960424	0905	2.37	0.064	15.6	64	65	0.53	1.06	5.74	25	0.02
960424	1134	2.63	0.083	12.0	60	64	0.50	1.16	6.58	21	0.15
960424	1336	2.77	0.074	13.6	60	63	0.47	1.12	7.51	21	0.10
960424	1636	3.18	0.074	13.6	62	64	0.43	1.42	8.64	17	0.18
960424	1937	3.57	0.074	13.6	66	67	0.43	0.77	8.10	20	0.08
960424	2236	3.30	0.074	13.6	64	65	0.42	0.37	8.04	20	0.02
960425	0133	3.22	0.074	13.6	60	63	0.43	0.63	7.14	21	0.16
960425	0436	3.30	0.074	13.6	68	68	0.46	0.13	5.95	25	0.02
960425	0734	3.27	0.074	13.6	66	66	0.46	0.20	5.50	26	0.03
960425	1037	3.22	0.074	13.6	60	62	0.45	0.58	6.23	24	0.10
960425	1629	3.07	0.083	12.0	60	61	0.44	0.41	6.16	25	0.07
960425	1937	3.31	0.074	13.6	60	61	0.43	0.45	6.81	23	0.09
960425	2237	3.17	0.074	13.6	62	62	0.42	0.29	7.60	20	-0.07
960426	0137	3.01	0.083	12.0	60	58	0.42	0.47	7.15	22	-0.10
960426	0437	3.10	0.074	13.6	60	59	0.43	0.50	7.18	23	-0.02
960426	0737	3.12	0.074	13.6	62	60	0.43	0.41	7.44	22	-0.07
960426	1037	3.01	0.083	12.0	62	61	0.40	0.41	8.44	20	-0.08
960426	1335	2.73	0.083	12.0	60	59	0.45	0.69	6.91	25	-0.11
960426	1636	2.81	0.083	12.0	62	60	0.43	0.56	7.68	21	-0.18
960426	2232	2.98	0.083	12.0	62	62	0.42	0.46	7.52	22	-0.02

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960427	0134	3.25	0.083	12.0	60	60	0.41	0.75	8.18	20	-0.06
960427	0434	3.34	0.083	12.0	58	61	0.44	0.61	6.97	24	0.07
960427	0734	3.68	0.093	10.7	60	62	0.41	0.92	7.94	21	0.04
960427	1035	3.90	0.083	12.0	56	58	0.42	0.94	8.04	20	0.04
960427	1336	3.98	0.083	12.0	56	57	0.42	1.01	7.86	21	0.01
960427	1634	3.59	0.083	12.0	56	58	0.44	1.52	8.36	19	0.03
960427	1936	3.54	0.083	12.0	56	61	0.49	1.77	6.54	21	0.20
960427	2236	3.71	0.083	12.0	56	63	0.50	1.45	6.08	25	0.30
960428	0136	3.69	0.083	12.0	30	41	0.54	1.69	5.92	23	0.55
960428	0434	3.48	0.083	12.0	54	59	0.53	1.88	6.22	24	0.18
960428	1357	3.63	0.083	12.0	58	60	0.50	1.75	6.77	23	0.07
960428	1611	3.17	0.083	12.0	60	62	0.53	1.66	6.13	26	0.07
960428	1911	2.96	0.083	12.0	60	66	0.54	1.85	6.09	23	0.25
960428	2212	2.57	0.083	12.0	62	69	0.56	1.79	5.68	24	0.37
960429	0109	2.42	0.083	12.0	58	64	0.58	1.95	5.60	25	0.25
960429	0752	2.33	0.083	12.0	56	62	0.60	2.51	5.65	21	0.23
960429	1037	2.18	0.103	9.7	54	65	0.70	1.94	3.95	33	0.57
960429	1335	2.16	0.103	9.7	60	72	0.67	1.72	3.92	33	0.47
960429	1513	2.03	0.103	9.7	64	73	0.71	1.52	3.53	37	0.40
960429	1637	1.84	0.113	8.9	64	71	0.72	1.52	3.55	40	0.34
960429	1937	1.72	0.103	9.7	56	72	0.79	1.80	3.11	48	0.87
960429	2237	1.65	0.113	8.9	54	73	0.78	1.81	3.06	50	1.13
960430	0137	1.47	0.113	8.9	56	76	0.79	1.39	2.81	60	0.91
960430	0437	1.45	0.064	15.6	54	79	0.87	1.31	2.35	94	1.48
960430	0908	1.34	0.064	15.6	52	82	0.89	1.19	2.15	102	1.62
960430	1037	1.29	0.064	15.6	52	87	0.91	0.88	1.91	106	1.35
960430	1438	1.24	0.074	13.6	54	85	0.91	1.02	2.04	103	1.40
960430	1636	1.21	0.074	13.6	54	92	0.92	0.66	1.78	105	1.16
960430	1936	1.28	0.083	12.0	56	80	0.88	1.33	2.35	96	1.53
960430	2236	1.43	0.083	12.0	52	72	0.79	1.85	3.14	49	0.94
960501	0134	1.53	0.093	10.7	52	67	0.73	2.18	3.88	35	0.64
960501	0436	1.54	0.093	10.7	46	62	0.76	2.31	3.78	37	0.59
960501	0735	1.47	0.083	12.0	48	62	0.73	2.49	4.13	34	0.59
960501	1115	1.52	0.083	12.0	48	65	0.78	2.42	3.59	37	0.90
960501	1530	1.73	0.093	10.7	50	58	0.66	2.64	5.36	29	0.24
960502	0756	1.52	0.132	7.6	52	62	0.75	3.30	4.43	24	0.40
960502	1017	1.49	0.113	8.9	48	59	0.79	3.16	4.17	24	0.59
960502	1636	1.34	0.123	8.2	52	64	0.82	2.79	3.67	29	0.58
960502	1935	1.20	0.132	7.6	52	67	0.91	2.38	2.93	72	1.54
960503	0658	1.49	0.142	7.0	32	61	0.81	2.53	3.58	43	0.25
960503	0958	1.40	0.142	7.0	58	66	0.90	2.30	2.90	64	0.80
960503	1335	1.36	0.142	7.0	56	64	0.85	2.44	3.25	48	0.43
960503	1632	1.53	0.142	7.0	26	57	0.80	2.25	3.58	50	0.30
960503	1935	1.53	0.142	7.0	50	57	0.78	2.67	3.83	36	0.26
960503	2235	1.73	0.132	7.6	54	56	0.71	3.14	4.97	27	0.00
960504	0136	1.82	0.132	7.6	50	53	0.72	3.05	4.74	31	0.08
960504	0436	1.91	0.123	8.2	58	55	0.71	2.37	4.60	38	-0.19
960504	0736	1.88	0.132	7.6	58	55	0.71	2.56	4.66	35	-0.07
960504	1035	1.73	0.132	7.6	32	56	0.76	2.65	4.11	38	0.11
960504	1336	1.61	0.142	7.0	30	56	0.80	2.90	3.94	40	0.15
960504	1636	1.55	0.123	8.2	32	56	0.77	2.69	4.07	38	0.12
960504	1936	1.54	0.162	6.2	56	58	0.78	3.01	4.09	33	0.10
960504	2236	1.26	0.113	8.9	40	69	0.94	1.90	2.44	111	1.86

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	A
960505	0436	1.29	0.162	6.2	54	67	0.93	1.93	2.68	78	1.10
960505	0735	1.20	0.152	6.6	56	71	0.93	1.67	2.48	97	1.36
960505	1036	1.22	0.113	8.9	46	65	0.90	2.56	2.97	71	1.45
960505	1336	1.11	0.074	13.6	54	75	0.99	1.54	2.17	115	1.68
960505	1633	1.07	0.074	13.6	36	60	1.04	1.74	2.40	104	1.38
960505	1932	1.07	0.162	6.2	58	76	0.94	1.56	2.31	106	1.64
960505	2236	1.13	0.162	6.2	54	70	0.93	1.96	2.62	88	1.65
960506	0136	1.26	0.162	6.2	54	62	0.90	2.23	2.85	71	0.98
960506	0736	1.45	0.152	6.6	54	55	0.69	2.85	4.84	27	-0.23
960506	1036	1.40	0.152	6.6	54	54	0.71	2.66	4.46	33	-0.08
960506	1636	1.33	0.152	6.6	52	59	0.73	1.31	3.53	46	0.29
960506	1934	1.33	0.152	6.6	60	59	0.69	1.06	3.68	44	-0.06
960508	1459	1.08	0.132	7.6	28	56	0.80	1.59	3.26	57	0.57
960508	1637	1.01	0.132	7.6	38	57	0.83	1.45	3.02	62	0.54
960508	1937	0.93	0.162	6.2	32	69	0.82	0.94	2.68	65	0.23
960508	2237	1.16	0.162	6.2	30	37	0.70	1.47	4.80	24	0.18
960509	0136	1.32	0.152	6.6	40	55	0.71	1.65	4.00	43	0.25
960509	0437	1.65	0.132	7.6	34	50	0.59	1.92	5.25	34	0.54
960509	0736	1.75	0.142	7.0	34	48	0.57	1.77	5.30	34	0.62
960509	1037	1.95	0.132	7.6	34	46	0.53	1.59	5.92	33	0.53
960509	1336	1.97	0.132	7.6	26	44	0.56	1.66	5.75	36	0.32
960509	1634	1.82	0.123	8.2	22	45	0.58	1.27	5.00	41	0.23
960509	2236	2.36	0.132	7.6	34	46	0.49	1.66	7.17	29	0.18
960510	0136	2.37	0.123	8.2	30	46	0.46	1.17	7.24	31	0.09
960510	0736	2.19	0.123	8.2	38	48	0.49	1.87	7.58	27	0.28
960510	1036	2.03	0.123	8.2	44	49	0.48	2.26	8.69	23	0.18
960510	1335	2.00	0.132	7.6	44	48	0.52	1.84	7.26	29	0.20
960510	1635	1.82	0.113	8.9	48	51	0.52	2.09	7.70	24	0.08
960510	1936	1.77	0.132	7.6	50	54	0.54	1.95	7.26	27	0.08
960510	2235	1.87	0.123	8.2	56	54	0.53	1.96	6.93	29	-0.02
960511	0136	1.93	0.123	8.2	58	55	0.50	1.97	7.82	27	-0.27
960511	0435	1.44	0.123	8.2	52	55	0.62	3.37	6.39	22	0.01
960511	0735	1.23	0.132	7.6	52	56	0.72	3.13	4.98	28	0.13
960511	1036	1.21	0.142	7.0	54	65	0.76	3.01	4.09	27	0.41
960511	1332	1.15	0.142	7.0	58	69	0.92	1.95	2.98	50	0.67
960511	1636	1.16	0.142	7.0	50	66	0.82	2.18	3.27	43	0.57
960511	1936	1.06	0.142	7.0	52	76	0.95	1.60	2.29	108	1.80
960511	2235	0.91	0.142	7.0	176	88	0.97	0.82	1.78	116	1.45
960512	0135	0.87	0.152	6.6	62	90	0.97	0.84	1.81	114	1.44
960512	0435	0.84	0.064	15.6	178	101	0.99	0.33	1.61	116	0.76
960512	1035	1.20	0.152	6.6	56	75	0.87	1.24	2.43	77	1.00
960512	1332	1.23	0.152	6.6	60	75	0.85	1.59	2.73	66	1.16
960512	1633	1.18	0.152	6.6	36	90	0.99	0.21	1.64	112	0.41
960512	1935	1.23	0.064	15.6	58	78	0.91	1.23	2.27	93	1.15
960512	2236	1.30	0.152	6.6	62	72	0.85	1.39	2.81	63	0.56
960513	0136	1.61	0.142	7.0	32	62	0.71	1.71	3.91	47	0.02
960513	0436	1.85	0.132	7.6	64	62	0.64	1.93	4.66	36	-0.01
960513	0736	1.96	0.132	7.6	50	58	0.64	2.35	5.38	30	0.19
960513	1036	1.76	0.132	7.6	30	59	0.72	1.67	4.02	45	-0.12
960513	1340	1.80	0.142	7.0	30	60	0.72	1.52	3.46	47	-0.01
960513	1636	1.71	0.132	7.6	28	61	0.75	1.51	3.27	52	0.18
960513	1936	1.54	0.142	7.0	26	61	0.76	1.52	3.58	50	0.00
960513	2236	1.50	0.152	6.6	32	71	0.81	1.05	2.70	65	0.27

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960514	0136	1.43	0.152	6.6	26	67	0.82	1.21	2.76	67	0.03
960514	0436	1.28	0.074	13.6	28	81	0.85	0.71	2.21	86	0.32
960514	0736	1.16	0.074	13.6	74	89	0.84	0.79	2.23	82	0.97
960514	1033	1.13	0.074	13.6	76	107	0.85	0.35	2.27	81	0.64
960514	1335	1.11	0.074	13.6	74	101	0.80	0.53	2.34	77	0.87
960514	1635	1.09	0.074	13.6	78	105	0.82	0.38	2.17	79	0.84
960514	1934	1.08	0.064	15.6	72	112	0.82	0.16	1.90	84	0.50
960514	2236	0.99	0.074	13.6	76	112	0.84	0.14	2.09	84	0.33
960515	0135	1.00	0.074	13.6	80	108	0.82	0.23	2.01	82	0.68
960515	0436	0.97	0.074	13.6	70	114	0.83	0.12	1.94	86	0.14
960515	0754	1.03	0.064	15.6	154	122	0.86	-0.22	2.03	82	-0.90
960515	1034	1.05	0.064	15.6	168	124	0.87	-0.27	1.95	87	-0.35
960515	1336	1.08	0.074	13.6	168	120	0.84	-0.09	2.04	83	0.19
960515	1635	1.05	0.074	13.6	170	127	0.85	-0.44	2.01	86	-0.66
960515	1936	1.07	0.064	15.6	174	137	0.89	-0.75	2.08	95	-1.09
960515	2235	1.15	0.054	18.5	170	133	0.92	-0.73	1.97	100	-1.22
960516	0135	1.19	0.054	18.5	166	128	0.93	-0.67	1.88	100	-1.21
960516	0435	1.30	0.054	18.5	170	137	0.87	-1.01	2.13	96	-1.59
960516	0735	1.46	0.054	18.5	174	136	0.86	-0.89	2.15	89	-1.32
960516	1035	1.70	0.064	15.6	174	128	0.85	-0.36	2.05	86	-0.20
960516	1335	1.82	0.064	15.6	176	132	0.82	-0.54	2.28	77	-0.07
960516	1635	1.84	0.064	15.6	176	134	0.84	-0.67	2.18	82	-0.35
960516	1935	1.86	0.064	15.6	178	137	0.83	-0.64	2.34	77	-0.37
960516	2237	2.00	0.064	15.6	174	135	0.81	-0.61	2.23	82	-0.67
960517	0136	1.96	0.064	15.6	172	134	0.84	-0.47	2.08	83	-0.59
960517	0435	1.83	0.064	15.6	168	130	0.81	-0.24	2.17	77	-0.27
960517	0735	2.19	0.064	15.6	96	127	0.78	0.08	2.08	78	1.01
960517	1036	2.23	0.064	15.6	94	124	0.78	0.46	2.10	80	1.22
960517	1335	2.08	0.064	15.6	96	129	0.79	-0.01	2.06	80	0.49
960517	1936	1.81	0.064	15.6	92	132	0.78	-0.19	2.15	80	-0.38
960517	2235	1.80	0.064	15.6	80	131	0.90	-0.04	2.36	83	-0.41
960518	0136	1.74	0.064	15.6	176	130	0.75	-0.15	2.30	75	-0.09
960518	0501	1.60	0.074	13.6	174	131	0.75	-0.14	2.22	75	0.06
960518	1101	1.61	0.064	15.6	178	117	0.85	0.11	1.82	93	0.47
960518	1336	1.63	0.074	13.6	74	112	0.80	0.28	1.97	84	0.64
960518	1636	1.69	0.113	8.9	90	108	0.76	0.43	2.31	69	1.04
960518	1935	1.68	0.064	15.6	86	108	0.76	0.36	2.13	75	1.02
960518	2236	2.37	0.093	10.7	72	84	0.61	1.66	4.35	27	0.70
960519	0204	3.56	0.083	12.0	72	78	0.46	1.69	7.55	16	0.24
960519	0435	3.61	0.074	13.6	76	80	0.45	1.57	7.30	17	0.17
960519	1101	3.54	0.074	13.6	74	77	0.44	1.96	8.70	13	0.15
960519	1335	3.32	0.074	13.6	72	75	0.46	1.45	7.59	16	0.13
960519	1659	3.67	0.074	13.6	70	73	0.44	0.98	7.33	18	0.34
960519	1935	3.49	0.074	13.6	70	73	0.46	0.86	6.78	18	0.29
960519	2302	3.25	0.074	13.6	70	71	0.48	1.10	6.95	17	0.13
960520	0136	3.06	0.083	12.0	70	71	0.53	0.94	5.76	23	-0.01
960520	0504	2.84	0.074	13.6	72	71	0.52	0.49	5.13	28	-0.14
960520	0736	2.81	0.074	13.6	70	69	0.50	0.34	5.57	27	-0.09
960520	1053	2.70	0.083	12.0	72	66	0.53	0.46	5.02	30	-0.45
960520	1336	2.72	0.083	12.0	68	63	0.55	0.64	4.93	35	-0.40
960520	1636	2.96	0.083	12.0	76	64	0.55	0.34	4.28	39	-0.43
960520	1936	3.00	0.132	7.6	76	64	0.54	0.15	4.49	38	-0.72
960520	2236	2.71	0.132	7.6	76	63	0.55	0.24	4.40	40	-0.82

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960521	0135	2.34	0.132	7.6	78	67	0.60	0.51	4.20	41	-0.64
960521	0434	2.19	0.142	7.0	78	65	0.58	0.69	4.36	43	-0.50
960521	0807	1.90	0.142	7.0	80	66	0.63	0.90	4.08	45	-0.37
960521	1041	1.73	0.093	10.7	80	67	0.66	0.81	3.71	45	-0.35
960521	1333	1.62	0.093	10.7	76	72	0.65	1.04	4.14	37	-0.28
960521	1636	1.50	0.103	9.7	68	78	0.69	1.06	3.57	40	0.06
960521	1936	1.37	0.113	8.9	86	83	0.70	0.89	3.44	39	-0.22
960521	2300	1.21	0.093	10.7	86	92	0.78	0.80	2.82	47	0.53
960522	0136	1.20	0.093	10.7	82	100	0.80	0.80	2.42	77	1.25
960522	0434	1.13	0.103	9.7	80	97	0.80	0.75	2.39	76	0.98
960522	0736	1.73	0.103	9.7	88	80	0.59	0.78	4.28	34	-0.17
960522	1036	2.41	0.103	9.7	78	71	0.57	0.32	4.42	34	-0.35
960522	1335	2.80	0.132	7.6	76	68	0.55	0.17	4.22	37	-0.56
960522	1658	2.79	0.113	8.9	74	69	0.57	0.26	3.81	38	-0.24
960522	1936	2.99	0.113	8.9	82	70	0.56	0.33	3.92	39	-0.44
960522	2235	3.47	0.103	9.7	78	62	0.53	0.52	4.13	42	-0.18
960523	0158	3.41	0.103	9.7	64	59	0.53	0.94	4.77	37	-0.02
960523	0436	3.36	0.103	9.7	38	58	0.51	0.75	4.70	38	-0.03
960523	0735	3.13	0.103	9.7	58	58	0.54	0.89	5.41	29	-0.03
960523	1036	3.04	0.103	9.7	36	54	0.55	1.21	4.87	38	0.28
960523	1957	3.32	0.103	9.7	40	53	0.51	1.15	5.39	35	0.34
960523	2236	3.57	0.103	9.7	46	52	0.49	1.24	5.79	31	0.20
960524	0157	3.59	0.103	9.7	52	53	0.46	1.46	7.10	26	0.04
960524	0435	3.02	0.093	10.7	50	55	0.50	1.69	6.82	26	0.21
960524	0735	3.14	0.093	10.7	48	54	0.47	1.61	7.27	25	0.26
960524	1036	3.12	0.093	10.7	40	48	0.50	1.56	6.43	28	0.27
960524	1335	3.14	0.093	10.7	40	49	0.50	2.04	6.74	25	0.32
960524	1701	2.94	0.093	10.7	46	52	0.51	2.28	7.21	22	0.36
960524	1934	2.54	0.103	9.7	44	52	0.54	2.18	6.64	25	0.41
960524	2231	2.31	0.093	10.7	42	53	0.61	2.23	5.39	30	0.69
960525	0135	2.15	0.103	9.7	48	60	0.62	2.43	5.26	27	0.64
960525	0457	2.18	0.103	9.7	50	60	0.59	2.10	5.40	27	0.56
960525	0735	2.32	0.103	9.7	48	59	0.57	2.21	5.88	28	0.58
960525	1036	2.04	0.103	9.7	46	61	0.62	2.22	5.15	31	0.67
960525	1357	2.18	0.113	8.9	50	57	0.60	2.26	5.70	25	0.28
960525	1635	2.27	0.103	9.7	48	55	0.57	3.10	6.87	18	0.44
960525	1935	2.31	0.093	10.7	46	53	0.56	2.83	6.94	21	0.46
960525	2236	2.16	0.093	10.7	46	55	0.63	2.53	5.62	27	0.36
960526	0735	1.60	0.103	9.7	46	62	0.74	2.33	4.00	37	1.04
960526	1035	1.54	0.103	9.7	48	66	0.75	2.07	3.56	42	1.33
960526	1336	1.46	0.103	9.7	46	69	0.80	1.89	2.97	60	1.59
960526	1635	1.47	0.113	8.9	44	70	0.84	1.75	2.83	69	1.32
960526	1935	1.50	0.113	8.9	48	65	0.75	2.30	3.65	35	0.99
960526	2233	1.54	0.113	8.9	48	68	0.77	1.93	3.30	44	0.94
960527	0157	1.67	0.113	8.9	46	64	0.75	2.15	3.68	36	0.72
960527	0435	1.91	0.083	12.0	50	64	0.71	2.07	3.90	34	0.57
960527	0735	2.32	0.132	7.6	50	60	0.65	2.29	4.75	29	0.42
960527	1035	2.75	0.083	12.0	48	54	0.56	2.63	6.46	22	0.27
960527	1337	2.99	0.093	10.7	46	52	0.54	3.13	7.42	20	0.37
960527	1635	3.36	0.093	10.7	48	51	0.49	3.68	9.19	15	0.12
960527	1933	3.39	0.083	12.0	46	52	0.53	3.53	7.84	16	0.24
960527	2236	3.31	0.083	12.0	48	52	0.51	3.39	8.30	16	0.12
960528	0136	3.34	0.083	12.0	46	51	0.48	3.30	9.13	16	0.31

(Sheet 15 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960528	0736	2.98	0.083	12.0	48	53	0.52	3.39	8.23	16	0.16
960528	1030	3.44	0.083	12.0	46	51	0.52	3.99	8.27	14	0.32
960528	1331	3.30	0.083	12.0	44	49	0.54	3.59	7.70	17	0.31
960528	1630	3.05	0.093	10.7	44	49	0.54	3.61	8.10	16	0.23
960528	1931	2.81	0.093	10.7	48	52	0.57	3.05	6.92	19	0.08
960529	0430	2.94	0.093	10.7	46	51	0.55	3.47	7.32	18	0.30
960529	0825	2.63	0.103	9.7	44	52	0.62	3.12	5.87	24	0.31
960529	1331	2.76	0.103	9.7	42	50	0.54	3.09	7.24	20	0.37
960529	1631	2.68	0.093	10.7	44	49	0.55	3.39	7.63	19	0.17
960529	2231	2.36	0.103	9.7	44	52	0.61	2.89	5.89	23	0.33
960530	0431	2.56	0.103	9.7	46	50	0.54	2.88	7.15	23	0.18
960530	0732	2.26	0.103	9.7	48	52	0.61	2.78	5.92	27	0.11
960530	1630	2.50	0.103	9.7	44	51	0.58	2.83	6.47	23	0.42
960530	1930	2.68	0.103	9.7	44	54	0.66	2.92	5.29	29	0.34
960530	2230	2.70	0.103	9.7	46	54	0.63	3.02	5.70	26	0.38
960531	0130	2.66	0.103	9.7	42	55	0.68	2.86	4.85	32	0.75
960531	0729	2.46	0.113	8.9	44	54	0.65	2.68	5.30	31	0.34
960531	1028	2.35	0.123	8.2	38	54	0.73	2.72	4.41	37	0.65
960531	1928	2.17	0.132	7.6	42	59	0.79	2.12	3.47	47	0.46
960531	2228	2.10	0.132	7.6	52	61	0.83	2.24	3.28	46	0.36
960601	0128	2.18	0.123	8.2	50	58	0.72	2.32	4.34	38	0.21
960601	0428	2.08	0.123	8.2	34	57	0.72	2.29	4.22	41	0.20
960601	0728	2.05	0.132	7.6	60	64	0.81	2.00	3.24	44	0.16
960601	1028	1.80	0.142	7.0	30	67	0.97	1.72	2.33	117	1.37
960601	1329	1.73	0.142	7.0	34	66	0.90	1.88	2.75	69	0.72
960601	1629	1.79	0.142	7.0	32	62	0.89	2.40	3.05	54	0.49
960601	1929	1.63	0.142	7.0	62	63	0.89	2.29	3.05	53	0.20
960602	0429	1.32	0.142	7.0	52	98	1.05	0.44	1.42	123	1.38
960602	0729	1.36	0.142	7.0	46	84	1.02	1.03	1.76	124	1.55
960602	1329	1.20	0.074	13.6	-178	113	1.04	0.06	1.39	123	0.45
960602	1629	1.20	0.142	7.0	72	91	0.96	0.93	1.92	113	1.18
960602	2229	1.16	0.074	13.6	58	107	1.03	0.34	1.55	116	0.93
960603	0129	1.15	0.074	13.6	64	95	0.96	0.89	1.88	108	1.74
960603	0429	1.24	0.074	13.6	64	95	0.93	0.90	1.94	105	1.75
960603	0729	1.29	0.083	12.0	66	82	0.83	1.61	2.80	62	1.44
960603	1628	1.28	0.083	12.0	64	73	0.80	2.17	3.44	35	0.51
960603	1929	1.35	0.083	12.0	62	71	0.79	1.94	3.45	39	0.43
960603	2230	1.39	0.093	10.7	66	73	0.75	1.98	3.68	32	0.25
960604	0130	1.47	0.142	7.0	70	76	0.77	1.32	3.08	47	0.17
960604	0430	1.54	0.132	7.6	66	66	0.73	2.15	4.23	38	0.03
960604	0729	1.87	0.132	7.6	54	60	0.61	1.76	5.37	35	0.02
960604	1630	1.97	0.113	8.9	68	57	0.61	1.74	5.34	37	-0.08
960604	1929	1.96	0.123	8.2	66	56	0.62	1.47	4.98	40	-0.27
960604	2229	2.04	0.123	8.2	58	56	0.60	1.80	5.51	32	-0.14
960605	0130	2.08	0.113	8.9	56	59	0.54	2.32	6.70	22	0.09
960605	0429	1.90	0.113	8.9	60	61	0.60	1.96	5.44	28	-0.02
960605	0729	1.77	0.113	8.9	52	57	0.63	2.30	5.32	28	0.10
960605	1030	1.78	0.113	8.9	50	59	0.66	2.42	4.74	26	0.46
960605	1331	1.80	0.103	9.7	48	60	0.66	2.33	4.71	25	0.85
960605	1631	2.05	0.103	9.7	46	59	0.65	2.12	4.54	33	0.80
960605	1931	1.96	0.103	9.7	46	58	0.63	2.32	5.01	28	0.54
960605	2231	1.64	0.103	9.7	46	64	0.68	2.03	4.00	33	0.83

(Sheet 16 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960606	0131	1.52	0.103	9.7	50	70	0.73	1.79	3.38	44	1.38
960606	0432	1.47	0.103	9.7	48	77	0.81	1.07	2.38	84	1.76
960606	0731	1.60	0.113	8.9	48	67	0.75	1.69	3.16	50	1.33
960606	1031	1.57	0.113	8.9	50	65	0.71	1.97	3.62	37	1.17
960606	1331	1.58	0.123	8.2	44	62	0.75	1.62	3.31	45	0.94
960606	1631	1.62	0.123	8.2	46	62	0.72	1.87	3.84	37	0.67
960606	1931	1.54	0.123	8.2	40	62	0.74	1.91	3.46	41	0.80
960606	2232	1.54	0.123	8.2	44	58	0.68	2.29	4.19	31	0.61
960607	0131	1.31	0.113	8.9	50	64	0.72	2.20	3.85	31	0.98
960607	0431	1.34	0.123	8.2	48	64	0.76	1.93	3.39	41	1.29
960607	0731	1.26	0.123	8.2	44	65	0.79	1.60	3.02	60	1.47
960607	1031	1.42	0.123	8.2	44	62	0.73	1.79	3.32	46	1.30
960607	1331	1.46	0.123	8.2	40	57	0.74	1.95	3.69	42	0.85
960607	1632	1.56	0.113	8.9	40	58	0.71	1.88	3.86	41	0.79
960607	1929	1.61	0.113	8.9	38	51	0.66	2.41	4.79	32	0.63
960607	2231	1.73	0.113	8.9	38	51	0.64	2.44	5.04	32	0.54
960608	0131	1.87	0.103	9.7	42	53	0.59	2.49	6.06	28	0.37
960608	0431	1.69	0.083	12.0	46	58	0.59	2.09	5.81	27	0.31
960608	0730	1.90	0.093	10.7	42	58	0.59	2.29	5.99	28	0.15
960608	1032	2.07	0.083	12.0	58	55	0.56	1.78	5.85	30	-0.27
960608	1331	1.93	0.132	7.6	56	57	0.58	1.47	5.30	30	0.00
960608	1630	1.86	0.103	9.7	48	59	0.58	1.64	5.60	32	0.12
960608	1931	1.81	0.093	10.7	56	59	0.61	1.63	5.12	36	0.09
960608	2231	1.80	0.113	8.9	62	59	0.59	1.34	5.11	36	-0.14
960609	0131	1.90	0.103	9.7	54	61	0.59	1.73	5.25	32	0.18
960609	0431	1.95	0.103	9.7	56	60	0.55	2.12	6.36	25	0.16
960609	0731	2.10	0.103	9.7	62	59	0.53	1.50	6.66	28	-0.13
960609	1031	2.16	0.113	8.9	46	55	0.51	1.92	6.85	26	0.17
960609	1331	2.26	0.103	9.7	62	59	0.54	1.21	5.23	35	-0.03
960609	1631	2.33	0.113	8.9	42	59	0.54	1.66	5.68	31	0.18
960609	1931	2.55	0.113	8.9	44	55	0.53	1.52	5.83	31	0.14
960609	2232	2.91	0.103	9.7	38	57	0.51	1.28	5.49	32	-0.03
960610	0131	3.08	0.103	9.7	66	57	0.48	0.98	5.52	33	-0.10
960610	0425	2.75	0.103	9.7	70	58	0.52	1.04	5.08	36	-0.28
960610	0532	2.65	0.103	9.7	66	60	0.52	1.16	5.68	30	-0.42
960610	0633	2.62	0.103	9.7	64	59	0.52	1.34	5.84	29	-0.19
960610	0729	2.60	0.113	8.9	60	58	0.51	1.53	6.36	27	-0.12
960610	0926	2.57	0.113	8.9	54	59	0.51	1.40	5.84	28	0.16
960610	1329	2.83	0.113	8.9	46	54	0.49	1.35	5.77	29	0.22
960610	1527	2.76	0.113	8.9	64	52	0.52	1.00	5.28	36	-0.14
960610	1727	2.66	0.113	8.9	40	67	0.76	0.38	2.73	68	0.64
960610	1929	2.48	0.113	8.9	36	54	0.56	1.33	4.96	36	0.23
960610	2127	2.48	0.113	8.9	40	54	0.57	1.59	5.26	32	0.34
960610	2327	2.37	0.113	8.9	42	52	0.58	1.34	4.85	37	0.25
960611	0129	2.46	0.113	8.9	32	51	0.57	1.29	4.90	38	0.01
960611	0327	2.47	0.113	8.9	30	52	0.56	1.24	5.01	40	0.17
960611	0729	2.48	0.123	8.2	34	52	0.57	1.57	5.17	35	0.21
960611	0842	2.34	0.123	8.2	56	54	0.58	1.54	4.98	36	0.03
960611	1122	2.26	0.132	7.6	36	58	0.60	1.51	4.78	38	-0.08
960611	1329	2.25	0.123	8.2	62	60	0.58	1.52	5.01	34	-0.09
960611	1527	2.13	0.123	8.2	70	65	0.62	1.29	4.45	38	-0.22
960611	1727	2.19	0.123	8.2	68	63	0.60	1.29	4.98	35	-0.31
960611	1929	2.23	0.123	8.2	64	64	0.61	1.76	5.06	31	-0.16
960611	2127	2.14	0.113	8.9	66	62	0.63	1.69	4.78	35	-0.07
960611	2327	2.15	0.103	9.7	46	61	0.64	1.95	4.85	35	0.19

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960612	0129	2.17	0.113	8.9	66	63	0.61	1.78	4.92	33	-0.10
960612	0327	2.12	0.113	8.9	68	63	0.60	1.72	5.15	33	-0.31
960612	0527	2.15	0.103	9.7	38	58	0.62	2.06	5.16	34	0.11
960612	1225	2.17	0.103	9.7	46	57	0.56	2.30	6.32	27	0.59
960612	1329	2.22	0.103	9.7	46	57	0.57	2.16	5.87	30	0.69
960612	1527	2.24	0.103	9.7	42	54	0.57	2.31	5.99	30	0.63
960612	1727	2.27	0.103	9.7	42	51	0.58	2.68	6.42	26	0.39
960612	1929	2.20	0.093	10.7	46	51	0.59	3.00	6.71	23	0.32
960612	2127	2.20	0.103	9.7	46	51	0.58	2.64	6.45	25	0.25
960612	2327	2.20	0.103	9.7	46	52	0.61	2.45	5.67	30	0.27
960613	0129	2.20	0.103	9.7	46	56	0.61	2.43	5.40	31	0.53
960613	0324	2.32	0.103	9.7	46	56	0.56	2.36	6.13	28	0.37
960613	0525	2.32	0.103	9.7	40	54	0.58	2.27	5.75	31	0.45
960613	0729	2.15	0.103	9.7	42	52	0.57	2.49	6.29	26	0.41
960613	0927	2.30	0.103	9.7	46	52	0.54	2.22	6.70	25	0.21
960613	1127	2.24	0.103	9.7	46	52	0.55	2.31	6.50	25	0.22
960613	1328	2.21	0.103	9.7	46	54	0.55	2.34	6.37	26	0.17
960613	1527	2.16	0.103	9.7	40	53	0.57	1.75	5.63	32	0.22
960613	1724	2.31	0.103	9.7	48	52	0.57	1.78	5.38	32	0.17
960613	1929	2.35	0.103	9.7	40	50	0.54	1.93	6.03	28	0.31
960613	2127	2.40	0.103	9.7	38	48	0.53	1.98	6.58	27	0.31
960613	2327	2.32	0.103	9.7	38	49	0.55	1.84	6.02	31	0.36
960614	0129	2.27	0.113	8.9	34	51	0.55	1.85	5.84	33	0.42
960614	0327	2.30	0.113	8.9	40	54	0.53	1.45	5.67	33	0.29
960614	0527	2.05	0.113	8.9	44	54	0.54	1.74	5.91	31	0.33
960614	0729	1.91	0.113	8.9	40	53	0.55	2.05	6.17	30	0.33
960614	0927	1.92	0.103	9.7	44	55	0.56	2.28	6.17	27	0.32
960614	1127	2.02	0.103	9.7	42	51	0.53	2.33	6.91	25	0.32
960614	1329	2.17	0.103	9.7	40	51	0.51	1.84	6.61	29	0.29
960614	1629	2.40	0.103	9.7	48	53	0.47	1.54	7.41	27	0.25
960614	1929	2.32	0.103	9.7	46	51	0.49	1.81	7.18	26	0.21
960614	2229	2.45	0.093	10.7	46	51	0.45	1.80	8.65	21	0.42
960615	0129	2.37	0.093	10.7	40	50	0.48	1.59	6.89	28	0.31
960615	0429	2.48	0.103	9.7	46	51	0.45	1.21	7.00	29	0.28
960615	0729	2.34	0.103	9.7	40	49	0.47	1.44	6.96	28	0.25
960615	1029	2.35	0.103	9.7	52	51	0.44	1.36	8.29	26	-0.06
960615	1329	2.22	0.113	8.9	40	50	0.49	1.57	7.04	28	0.44
960615	1629	2.48	0.103	9.7	44	50	0.43	1.46	7.70	25	0.26
960615	1929	2.48	0.103	9.7	40	47	0.43	1.67	8.35	22	0.25
960615	2228	2.40	0.093	10.7	46	50	0.43	1.59	8.49	21	0.21
960616	0130	2.73	0.093	10.7	44	51	0.42	1.15	7.70	23	0.40
960616	0429	2.72	0.093	10.7	40	49	0.40	1.14	7.94	25	0.22
960616	0729	2.74	0.093	10.7	44	47	0.40	1.04	7.88	24	0.14
960616	1029	2.50	0.093	10.7	42	45	0.40	1.38	9.33	20	0.21
960616	1327	2.36	0.093	10.7	48	50	0.38	1.56	11.41	18	0.13
960616	1628	2.20	0.103	9.7	46	47	0.41	1.31	9.24	21	0.05
960616	1929	2.21	0.103	9.7	48	47	0.44	0.88	6.92	29	-0.03
960616	2229	2.14	0.103	9.7	46	49	0.44	1.18	7.75	23	0.19
960617	0129	2.12	0.093	10.7	48	52	0.43	1.27	8.40	20	0.21
960617	0429	2.10	0.103	9.7	50	53	0.44	1.11	7.65	22	0.08
960617	0729	2.10	0.093	10.7	42	50	0.43	1.11	7.05	27	0.36
960617	1029	2.21	0.093	10.7	42	48	0.44	1.18	7.54	26	0.25
960617	1329	2.18	0.103	9.7	50	49	0.45	1.06	7.44	24	-0.08
960617	1629	2.67	0.103	9.7	42	47	0.43	0.92	6.62	28	0.18
960617	1929	2.86	0.103	9.7	46	48	0.41	0.81	7.44	25	0.03

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960617	2229	3.03	0.103	9.7	48	49	0.39	0.82	7.49	25	-0.01
960618	0129	3.06	0.103	9.7	50	49	0.40	0.93	7.86	24	-0.07
960618	0429	2.74	0.103	9.7	48	48	0.42	1.24	8.62	22	-0.07
960618	0729	2.89	0.103	9.7	48	48	0.39	1.18	9.00	22	0.02
960618	1029	2.75	0.113	8.9	48	46	0.39	1.57	10.83	20	-0.12
960618	1329	2.78	0.103	9.7	48	49	0.44	1.40	8.80	21	-0.02
960618	1629	2.76	0.103	9.7	48	48	0.42	1.27	8.75	20	-0.12
960618	1929	2.76	0.103	9.7	48	50	0.42	1.27	8.49	20	0.05
960618	2228	2.68	0.103	9.7	50	51	0.44	1.38	8.47	21	0.09
960619	0127	2.69	0.103	9.7	48	51	0.45	1.48	8.12	20	0.16
960619	0427	2.53	0.113	8.9	52	55	0.48	1.15	6.80	25	0.14
960619	0727	2.33	0.113	8.9	48	52	0.46	1.25	7.91	22	0.20
960619	1028	2.18	0.103	9.7	50	54	0.47	1.38	7.87	22	0.18
960619	1327	2.01	0.103	9.7	52	56	0.50	1.78	7.74	20	0.23
960619	1927	1.93	0.113	8.9	50	57	0.52	1.19	6.09	28	0.38
960619	2227	1.65	0.113	8.9	50	57	0.55	1.67	6.49	27	0.19
960620	0127	1.61	0.113	8.9	58	61	0.52	1.90	7.52	22	0.18
960620	0427	1.52	0.123	8.2	56	59	0.56	1.79	6.44	23	0.15
960620	0727	1.58	0.123	8.2	54	57	0.57	1.20	5.54	31	0.09
960620	1627	1.74	0.132	7.6	52	52	0.63	0.79	4.69	35	-0.08
960620	1928	1.84	0.132	7.6	32	46	0.55	1.22	5.60	34	0.68
960620	2227	2.12	0.132	7.6	38	47	0.50	1.13	5.94	32	0.15
960621	0127	2.23	0.132	7.6	34	45	0.46	1.36	7.43	28	0.07
960621	0427	2.24	0.123	8.2	32	47	0.46	1.16	6.65	31	0.15
960621	0727	2.12	0.123	8.2	34	47	0.47	1.22	6.79	31	0.30
960621	1027	1.81	0.123	8.2	38	52	0.51	1.45	6.79	31	0.42
960621	1327	1.87	0.123	8.2	36	49	0.50	1.34	6.62	32	0.38
960621	1627	1.87	0.132	7.6	54	52	0.50	1.00	6.08	33	0.03
960621	1927	1.80	0.123	8.2	40	53	0.49	1.21	6.43	31	0.21
960621	2227	2.10	0.123	8.2	36	51	0.49	0.76	4.93	36	0.25
960622	0127	2.37	0.113	8.9	36	46	0.46	1.23	5.90	28	0.46
960622	0427	2.23	0.113	8.9	42	50	0.45	1.05	6.09	29	0.34
960622	0726	2.02	0.113	8.9	48	54	0.43	0.87	7.02	27	0.21
960622	1027	2.04	0.103	9.7	44	51	0.45	1.34	7.49	24	0.50
960622	1327	2.09	0.103	9.7	40	51	0.46	1.08	5.92	28	0.58
960622	1627	2.14	0.103	9.7	42	51	0.45	1.26	6.42	25	0.43
960622	1927	2.25	0.103	9.7	42	53	0.45	0.93	5.94	28	0.45
960622	2227	2.16	0.103	9.7	44	52	0.44	1.04	6.70	27	0.57
960623	0127	1.89	0.103	9.7	46	51	0.42	1.23	8.58	22	0.31
960623	0427	1.82	0.103	9.7	82	68	0.83	0.13	2.95	66	-0.21
960623	0725	1.89	0.103	9.7	48	52	0.42	1.29	8.22	21	0.28
960623	1027	1.85	0.113	8.9	48	56	0.44	1.19	8.03	24	0.52
960623	1327	1.88	0.113	8.9	44	53	0.45	1.34	7.96	24	0.32
960623	1627	1.83	0.113	8.9	44	50	0.47	1.41	7.09	23	0.27
960623	1926	1.74	0.113	8.9	46	56	0.46	1.49	7.64	24	0.49
960623	2227	1.98	0.113	8.9	50	57	0.43	1.37	8.08	21	0.32
960624	0126	2.14	0.113	8.9	50	51	0.39	1.35	9.81	21	0.02
960624	0426	2.03	0.123	8.2	52	54	0.45	1.54	8.05	20	0.05
960624	0726	1.79	0.123	8.2	50	52	0.52	1.10	6.09	26	0.01
960624	1026	1.75	0.132	7.6	44	51	0.52	1.72	6.54	22	0.36
960624	1326	1.38	0.142	7.0	48	55	0.58	1.47	5.64	32	0.20
960624	1630	1.13	0.152	6.6	50	58	0.68	1.44	4.41	39	0.22
960624	1927	0.94	0.152	6.6	44	67	0.80	1.52	3.11	56	0.68

(Sheet 19 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960624	2227	0.82	0.162	6.2	40	73	0.88	1.30	2.55	73	0.68
960625	0126	0.77	0.162	6.2	60	80	0.96	0.81	2.16	101	0.97
960625	0427	0.75	0.162	6.2	44	74	0.91	1.25	2.39	86	0.93
960625	0727	0.91	0.162	6.2	48	69	0.91	1.53	2.47	82	1.18
960625	1319	0.96	0.162	6.2	48	69	0.83	2.01	3.09	53	1.20
960625	1619	0.91	0.162	6.2	50	77	0.94	1.49	2.34	98	1.55
960625	1919	0.87	0.113	8.9	50	88	0.98	0.93	1.87	111	1.31
960625	2219	0.88	0.113	8.9	52	81	0.90	1.10	2.20	96	1.32
960626	0119	0.86	0.113	8.9	44	91	0.97	0.75	1.76	112	1.16
960626	0419	0.86	0.113	8.9	54	97	0.97	0.57	1.64	111	1.26
960626	0719	0.87	0.083	12.0	52	93	0.97	0.72	1.73	110	1.25
960626	1019	0.92	0.083	12.0	44	100	1.00	0.37	1.62	115	0.75
960626	1319	0.95	0.123	8.2	52	92	0.95	0.81	1.84	104	1.20
960626	1619	0.95	0.132	7.6	54	94	0.95	0.66	1.77	106	1.14
960626	1919	1.00	0.123	8.2	58	101	0.95	0.43	1.70	103	0.99
960626	2219	1.04	0.123	8.2	66	91	0.91	0.79	1.93	96	1.24
960627	0117	1.09	0.123	8.2	46	85	0.90	1.04	2.15	95	1.06
960627	0419	1.01	0.132	7.6	74	101	0.92	0.46	1.76	101	1.02
960627	0719	0.98	0.064	15.6	60	111	0.94	0.14	1.62	104	0.48
960627	1019	0.96	0.064	15.6	68	118	0.93	-0.10	1.65	103	-0.45
960627	1319	0.89	0.064	15.6	180	120	0.95	-0.20	1.65	106	-0.41
960627	1619	0.89	0.064	15.6	-178	120	0.95	-0.24	1.74	104	-0.47
960627	1919	0.90	0.064	15.6	158	131	0.91	-0.74	1.96	99	-1.35
960627	2219	0.92	0.064	15.6	164	127	0.89	-0.47	1.95	94	-0.75
960628	0119	0.97	0.064	15.6	160	130	0.88	-0.70	1.95	95	-1.23
960628	0419	0.92	0.064	15.6	168	122	0.93	-0.28	1.79	99	-0.47
960628	0719	0.98	0.064	15.6	162	119	0.89	-0.17	1.80	95	-0.41
960628	1019	1.02	0.064	15.6	64	114	0.88	0.01	1.73	95	-0.12
960628	1323	1.23	0.064	15.6	74	99	0.85	0.55	1.98	92	1.12
960628	1623	1.54	0.162	6.2	64	75	0.78	1.68	3.21	42	0.36
960628	1923	1.75	0.152	6.6	64	70	0.73	1.68	3.51	35	0.17
960628	2223	1.90	0.142	7.0	64	65	0.67	1.73	4.24	32	-0.08
960629	0123	1.85	0.074	13.6	68	71	0.64	1.55	4.51	32	0.00
960629	0423	1.70	0.074	13.6	62	71	0.71	1.86	4.03	36	0.12
960629	0723	1.83	0.074	13.6	60	65	0.66	1.73	4.49	36	0.06
960629	1023	1.72	0.083	12.0	66	68	0.66	1.92	4.73	33	0.08
960629	1323	1.77	0.142	7.0	56	70	0.65	1.51	4.23	39	0.40
960629	1623	1.74	0.083	12.0	74	69	0.64	1.28	4.71	35	-0.07
960629	1923	1.76	0.083	12.0	70	71	0.63	1.58	4.83	29	-0.03
960629	2223	1.85	0.132	7.6	70	69	0.62	1.52	4.96	31	-0.07
960630	0123	2.02	0.123	8.2	78	70	0.61	1.23	4.44	37	-0.27
960630	0423	2.07	0.123	8.2	76	70	0.64	1.44	4.32	35	-0.25
960630	0723	2.03	0.113	8.9	66	67	0.66	1.92	4.57	33	-0.05
960630	1023	2.10	0.113	8.9	60	68	0.78	2.18	3.90	30	0.28
960630	1323	2.17	0.113	8.9	42	63	0.69	1.94	4.17	39	0.33
960630	1623	2.41	0.113	8.9	58	63	0.90	0.91	2.88	51	0.51
960630	1923	2.27	0.103	9.7	54	72	0.83	1.36	2.83	56	0.74
960630	2223	2.28	0.054	18.5	164	85	0.90	1.01	1.91	110	1.71
960701	0123	2.13	0.054	18.5	60	88	0.86	1.11	2.13	103	1.73
960701	0423	2.11	0.054	18.5	168	93	0.90	0.80	1.78	108	1.42
960701	0731	2.14	0.054	18.5	38	60	1.02	1.57	2.43	104	2.06
960701	1023	1.99	0.054	18.5	48	99	1.00	0.38	1.42	116	1.22
960701	1323	1.98	0.054	18.5	44	94	0.98	0.56	1.58	115	1.09

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	A
960701	1623	2.16	0.054	18.5	56	86	0.92	1.04	1.94	110	1.55
960701	1923	2.13	0.054	18.5	56	83	0.91	1.20	2.06	108	1.77
960701	2223	1.83	0.064	15.6	58	90	0.92	0.91	1.82	107	2.01
960702	0123	1.75	0.064	15.6	60	100	0.92	0.46	1.63	103	1.46
960702	0737	1.67	0.064	15.6	162	98	0.96	0.43	1.54	109	1.27
960702	1022	1.74	0.064	15.6	168	105	0.98	0.19	1.41	113	1.05
960702	1623	1.78	0.064	15.6	168	94	0.99	0.44	1.45	119	1.12
960702	1923	1.78	0.064	15.6	168	107	1.02	-0.01	1.34	116	0.74
960703	0123	1.60	0.064	15.6	48	92	0.97	0.58	1.58	114	1.28
960703	0423	1.66	0.064	15.6	50	90	0.96	0.75	1.64	115	1.59
960703	0723	1.56	0.064	15.6	50	91	0.97	0.70	1.61	114	1.51
960703	1023	1.60	0.064	15.6	48	99	1.01	0.37	1.39	119	1.20
960703	1331	1.49	0.064	15.6	52	95	0.97	0.58	1.53	115	1.37
960703	1811	1.44	0.064	15.6	164	85	1.02	0.84	1.85	118	1.10
960703	1923	1.40	0.064	15.6	44	79	0.98	1.24	2.08	113	1.19
960703	2223	1.36	0.064	15.6	60	80	0.95	1.40	2.23	101	1.59
960704	0123	1.47	0.074	13.6	60	86	0.92	1.11	2.00	104	1.72
960704	0743	1.96	0.123	8.2	34	61	0.73	2.48	4.12	37	0.07
960704	1023	1.96	0.123	8.2	58	59	0.72	2.43	4.35	35	-0.10
960704	1323	2.07	0.132	7.6	56	56	0.70	2.29	4.53	36	0.08
960704	1623	2.31	0.132	7.6	54	53	0.68	2.06	4.68	37	0.00
960704	1923	2.13	0.132	7.6	28	52	0.72	1.88	4.17	46	0.29
960704	2223	1.93	0.132	7.6	30	56	0.76	1.70	3.62	48	0.02
960705	0656	2.28	0.123	8.2	72	59	0.60	1.02	4.38	43	-0.42
960705	1023	2.34	0.113	8.9	30	54	0.57	1.15	4.99	42	-0.07
960705	1323	2.19	0.113	8.9	30	52	0.59	1.54	5.49	38	0.06
960705	1623	2.38	0.103	9.7	40	50	0.54	1.63	6.32	32	0.20
960705	1923	2.21	0.103	9.7	50	52	0.59	1.30	5.32	35	0.04
960706	0423	1.88	0.103	9.7	46	55	0.55	1.84	6.08	26	0.58
960706	0723	1.88	0.103	9.7	46	54	0.55	1.85	6.06	27	0.48
960706	1023	1.93	0.103	9.7	54	61	0.80	0.63	3.26	46	0.35
960706	1323	1.74	0.103	9.7	46	54	0.57	1.88	5.86	26	0.38
960706	1623	1.51	0.103	9.7	44	54	0.60	2.42	6.10	25	0.63
960706	1923	1.65	0.103	9.7	42	53	0.58	1.47	5.40	36	0.52
960706	2223	1.69	0.103	9.7	44	53	0.56	1.76	5.95	30	0.55
960707	0123	1.45	0.113	8.9	42	53	0.60	2.11	5.84	30	0.49
960707	0423	1.32	0.103	9.7	42	55	0.61	2.02	5.50	34	0.67
960707	0723	1.29	0.103	9.7	44	57	0.62	1.80	5.14	35	0.62
960707	1023	1.28	0.103	9.7	46	55	0.58	2.23	6.07	26	0.54
960707	1323	1.37	0.103	9.7	44	51	0.58	2.39	6.51	25	0.40
960707	1623	1.26	0.103	9.7	44	54	0.64	2.56	5.67	27	0.38
960707	1923	1.23	0.103	9.7	48	55	0.66	1.67	4.88	27	0.34
960707	2223	1.28	0.113	8.9	42	55	0.60	1.83	5.22	33	0.69
960708	0123	1.28	0.113	8.9	42	53	0.62	2.18	5.59	30	0.64
960708	0423	1.13	0.103	9.7	44	55	0.68	2.02	4.64	35	0.54
960708	0723	1.06	0.103	9.7	44	55	0.65	2.20	5.27	28	0.27
960708	1022	1.10	0.113	8.9	48	57	0.66	2.06	5.21	28	0.31
960708	1623	1.07	0.113	8.9	46	57	0.70	1.89	4.53	31	0.46
960708	1923	1.14	0.113	8.9	52	58	0.62	2.23	5.57	25	0.22
960708	2223	1.40	0.113	8.9	52	55	0.54	2.00	6.57	25	0.16
960709	0123	1.61	0.113	8.9	48	53	0.47	1.94	8.37	22	0.22
960709	0423	1.55	0.113	8.9	46	52	0.51	2.32	7.62	21	0.26

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960709	0723	1.54	0.103	9.7	54	51	0.81	0.89	4.13	37	-0.16
960709	1033	1.71	0.113	8.9	46	51	0.49	1.70	7.74	22	0.26
960709	1323	2.02	0.113	8.9	48	50	0.41	1.61	10.46	18	0.12
960709	1623	2.10	0.093	10.7	50	52	0.41	1.81	11.38	16	0.11
960709	1917	2.17	0.093	10.7	52	53	0.41	1.68	11.64	16	-0.05
960709	2223	2.50	0.093	10.7	54	51	0.39	0.77	10.24	21	-0.19
960710	0123	2.72	0.093	10.7	54	51	0.39	1.14	11.02	20	-0.16
960710	0423	2.46	0.093	10.7	54	51	0.41	1.19	10.62	18	-0.21
960710	0722	2.16	0.093	10.7	56	53	0.45	1.46	9.81	17	-0.22
960710	1021	2.45	0.093	10.7	52	52	0.40	1.84	12.58	15	-0.03
960710	1621	2.29	0.093	10.7	48	51	0.43	1.56	11.18	19	0.09
960710	1921	2.08	0.093	10.7	54	56	0.43	2.90	12.79	12	0.02
960710	2221	1.81	0.093	10.7	54	56	0.49	2.89	9.89	14	0.04
960711	0121	1.92	0.103	9.7	56	56	0.44	2.42	11.04	14	-0.02
960711	0421	1.79	0.103	9.7	52	55	0.52	2.66	8.61	17	0.07
960711	0715	1.64	0.103	9.7	52	55	0.55	3.72	8.24	13	0.14
960711	1021	1.49	0.103	9.7	52	56	0.63	3.42	6.44	16	0.13
960711	1321	1.47	0.103	9.7	48	53	0.64	4.05	6.50	16	0.18
960711	1921	1.28	0.103	9.7	48	56	0.74	3.72	4.92	20	0.34
960711	2221	1.10	0.103	9.7	48	61	0.84	2.73	3.55	33	0.55
960712	0121	1.15	0.103	9.7	50	61	0.77	2.82	4.09	28	0.47
960712	0421	1.17	0.113	8.9	42	57	0.77	2.76	4.15	34	0.53
960712	0721	1.19	0.113	8.9	40	56	0.78	2.82	4.07	36	0.73
960712	1021	1.12	0.113	8.9	48	66	0.88	2.12	2.95	58	1.02
960712	1319	1.02	0.113	8.9	36	62	0.91	2.27	2.86	68	1.22
960712	1621	1.03	0.113	8.9	44	59	0.83	2.76	3.59	39	0.75
960712	1921	1.10	0.113	8.9	42	55	0.86	2.95	3.59	38	0.56
960712	2221	0.93	0.113	8.9	42	67	0.97	1.82	2.40	110	1.74
960713	0121	0.92	0.113	8.9	44	70	0.98	1.65	2.23	117	1.67
960713	0421	0.90	0.123	8.2	40	69	0.95	1.72	2.41	106	1.55
960713	0721	0.98	0.113	8.9	38	61	0.87	2.37	3.05	57	1.19
960713	1021	0.97	0.113	8.9	40	63	0.92	2.18	2.75	87	1.70
960713	1321	1.07	0.113	8.9	34	53	0.83	2.95	3.70	40	0.80
960713	1621	1.23	0.113	8.9	32	53	0.73	2.47	4.38	42	0.67
960713	1921	1.15	0.113	8.9	40	52	0.80	2.63	3.83	35	0.63
960713	2221	1.10	0.113	8.9	44	55	0.77	2.45	3.97	37	0.28
960714	0121	1.04	0.113	8.9	36	49	0.78	2.38	4.15	38	0.84
960714	0421	1.01	0.074	13.6	50	62	0.79	2.18	3.57	40	0.67
960714	0721	1.11	0.074	13.6	52	56	0.74	2.98	4.45	29	0.20
960714	1021	1.11	0.074	13.6	50	57	0.79	2.97	4.03	31	0.27
960714	1321	1.10	0.074	13.6	50	60	0.78	3.17	4.12	24	0.46
960714	1621	1.20	0.074	13.6	48	58	0.71	3.23	4.87	24	0.28
960714	1921	1.16	0.083	12.0	50	58	0.74	3.35	4.62	22	0.42
960714	2221	1.13	0.083	12.0	48	59	0.76	2.99	4.26	28	0.51
960715	0121	1.12	0.083	12.0	46	60	0.82	2.95	3.71	36	0.96
960715	0721	1.08	0.083	12.0	44	60	0.82	2.93	3.64	38	1.01
960715	1321	1.09	0.103	9.7	44	61	0.85	2.54	3.42	41	0.82
960715	1621	1.01	0.083	12.0	38	62	0.86	2.33	3.16	52	0.88
960715	1927	1.03	0.093	10.7	52	70	0.86	1.91	2.87	60	1.10
960715	2221	0.96	0.093	10.7	54	85	0.98	1.13	1.91	115	1.96
960716	0121	0.99	0.093	10.7	52	81	0.93	1.27	2.09	106	1.87
960716	0421	1.01	0.103	9.7	42	77	0.93	1.41	2.20	110	1.54
960716	0721	1.01	0.093	10.7	48	79	0.94	1.44	2.16	112	1.72

(Sheet 22 of 31)

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	A
960716	1017	1.00	0.093	10.7	46	86	1.03	0.99	1.67	123	1.93
960716	1316	1.00	0.093	10.7	42	91	1.03	0.64	1.52	125	1.26
960716	1915	1.08	0.093	10.7	46	88	1.03	0.90	1.63	123	1.76
960716	2216	1.14	0.093	10.7	40	71	1.02	1.77	2.08	128	2.24
960717	0116	1.25	0.093	10.7	44	65	0.90	2.44	2.81	94	2.29
960717	0416	1.60	0.103	9.7	46	61	0.80	3.17	3.76	32	1.03
960717	1016	1.68	0.103	9.7	44	58	0.82	3.24	3.74	33	1.17
960717	1316	1.63	0.103	9.7	40	59	0.86	2.81	3.28	49	1.53
960717	1916	1.68	0.113	8.9	42	58	0.83	3.06	3.64	37	0.86
960717	2216	1.40	0.064	15.6	44	76	1.01	1.48	2.03	120	1.99
960718	0116	1.50	0.113	8.9	42	70	0.97	1.86	2.29	118	2.24
960718	0416	1.63	0.064	15.6	38	68	0.94	1.79	2.40	100	1.66
960718	0716	1.65	0.132	7.6	38	66	0.92	1.96	2.59	97	1.59
960718	0816	1.71	0.132	7.6	40	64	0.91	2.30	2.80	79	1.57
960718	1016	1.59	0.132	7.6	40	67	0.90	2.14	2.77	79	1.40
960718	1323	1.47	0.142	7.0	42	70	0.92	1.88	2.56	94	1.52
960718	1616	1.59	0.142	7.0	36	60	0.86	2.50	3.23	54	0.87
960718	1916	1.81	0.132	7.6	36	55	0.77	2.65	4.02	41	0.48
960718	2216	1.90	0.123	8.2	46	51	0.70	3.37	5.06	24	0.21
960719	0116	2.04	0.123	8.2	42	48	0.64	2.81	5.78	27	0.22
960719	0416	2.06	0.113	8.9	40	50	0.62	3.06	6.24	25	0.44
960719	0716	1.98	0.113	8.9	42	51	0.62	2.75	5.87	29	0.49
960719	1022	1.95	0.113	8.9	40	52	0.65	2.86	5.50	32	0.55
960719	1316	1.70	0.113	8.9	44	55	0.71	2.55	4.73	33	0.39
960719	1616	1.67	0.113	8.9	44	56	0.65	2.01	5.02	35	0.48
960719	1914	1.71	0.113	8.9	40	53	0.60	2.21	5.95	31	0.58
960719	2216	1.84	0.113	8.9	40	51	0.61	2.71	6.24	29	0.56
960720	0116	1.78	0.103	9.7	40	49	0.58	2.79	7.05	23	0.58
960720	0416	1.84	0.103	9.7	42	53	0.56	2.01	6.38	30	0.83
960720	0716	1.82	0.103	9.7	44	55	0.51	2.47	7.87	25	0.50
960720	1016	1.87	0.103	9.7	44	53	0.54	2.23	7.06	27	0.46
960720	1316	1.89	0.103	9.7	40	51	0.55	2.32	7.25	26	0.43
960720	1616	1.98	0.113	8.9	42	49	0.51	2.34	7.97	21	0.35
960720	1916	1.79	0.113	8.9	38	49	0.52	2.14	7.49	27	0.41
960720	2216	1.60	0.113	8.9	46	53	0.59	3.08	6.87	24	0.32
960721	0116	1.44	0.113	8.9	46	55	0.64	3.18	6.09	25	0.47
960721	0416	1.39	0.113	8.9	44	55	0.66	3.69	5.94	25	0.58
960721	0716	1.38	0.113	8.9	32	45	0.76	2.18	4.82	31	0.76
960721	1016	1.38	0.113	8.9	50	59	0.71	3.35	4.94	25	0.44
960721	1316	1.46	0.113	8.9	50	56	0.65	3.77	6.21	21	0.35
960721	1616	1.28	0.113	8.9	44	56	0.74	3.06	4.63	28	1.02
960721	1916	1.49	0.103	9.7	44	55	0.70	3.92	5.34	23	0.81
960721	2216	1.46	0.103	9.7	42	51	0.68	3.96	5.69	22	0.59
960722	0116	1.46	0.113	8.9	50	57	0.66	4.36	6.00	17	0.50
960722	0416	1.38	0.103	9.7	48	59	0.72	3.36	4.85	23	0.58
960722	0716	1.38	0.113	8.9	44	56	0.75	3.91	4.76	25	0.62
960724	0925	1.98	0.054	18.5	162	153	0.70	-3.84	5.09	13	-0.43
960724	1017	1.90	0.054	18.5	162	153	0.74	-3.32	4.52	15	-0.44
960724	1317	2.02	0.054	18.5	162	154	0.72	-3.66	5.03	10	-0.27
960724	1617	2.02	0.054	18.5	160	156	0.68	-3.76	5.54	15	-0.01
960724	1917	1.83	0.054	18.5	160	151	0.80	-3.28	4.08	20	-0.49
960724	2217	2.06	0.054	18.5	162	149	0.79	-3.30	3.94	17	-0.89

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960725	0117	1.99	0.054	18.5	164	153	0.74	-3.38	4.36	14	-0.64
960725	0417	1.84	0.054	18.5	164	155	0.77	-3.28	4.24	15	-0.53
960725	0717	1.85	0.054	18.5	162	152	0.75	-2.97	4.18	18	-0.41
960725	1017	1.94	0.054	18.5	164	153	0.78	-3.21	4.02	17	-0.51
960725	1315	1.88	0.064	15.6	164	155	0.76	-3.10	4.37	19	-0.31
960725	1617	1.76	0.054	18.5	166	158	0.66	-4.07	5.95	12	-0.28
960725	1915	1.64	0.064	15.6	164	158	0.68	-3.20	5.44	15	-0.17
960725	2223	1.64	0.064	15.6	168	161	0.71	-3.16	4.96	17	-0.33
960726	0117	1.57	0.064	15.6	170	159	0.72	-2.99	4.54	22	-0.42
960726	0417	1.61	0.064	15.6	170	162	0.68	-3.39	5.47	19	-0.33
960726	0715	1.39	0.064	15.6	166	156	0.77	-2.48	3.86	27	-0.28
960726	1017	1.41	0.064	15.6	168	151	0.84	-2.38	3.21	40	-0.85
960726	1317	1.39	0.064	15.6	164	146	0.90	-2.21	2.79	90	-2.03
960726	1617	1.36	0.064	15.6	172	148	0.92	-2.15	2.66	102	-1.98
960726	1917	1.28	0.064	15.6	164	142	0.95	-1.29	2.16	109	-1.79
960726	2217	1.26	0.064	15.6	180	154	0.90	-1.91	2.71	78	-1.44
960727	0117	1.34	0.064	15.6	172	142	0.94	-1.32	2.06	111	-1.87
960727	0717	1.16	0.064	15.6	174	154	0.84	-2.03	3.05	45	-0.77
960727	1017	1.14	0.074	13.6	172	148	0.91	-2.09	2.70	90	-1.63
960727	1317	1.05	0.074	13.6	170	151	0.88	-2.18	2.98	48	-0.79
960727	1615	1.08	0.074	13.6	170	137	0.98	-1.11	1.92	115	-1.79
960727	1917	1.02	0.074	13.6	-180	132	1.01	-0.64	1.66	119	-1.13
960727	2217	1.08	0.074	13.6	168	148	0.88	-1.96	2.73	79	-1.63
960728	0417	0.89	0.074	13.6	166	152	0.83	-1.97	3.27	38	-0.68
960728	0717	0.93	0.074	13.6	172	152	0.90	-2.22	2.92	60	-1.46
960728	1017	0.97	0.074	13.6	170	144	0.96	-1.75	2.36	114	-1.82
960728	1317	0.90	0.074	13.6	174	146	0.95	-2.01	2.57	93	-1.30
960728	1915	0.88	0.074	13.6	170	157	0.78	-2.24	3.89	32	-0.62
960728	2224	0.86	0.074	13.6	174	151	0.90	-2.14	2.92	60	-1.21
960729	0117	0.84	0.074	13.6	168	150	0.85	-1.90	3.05	50	-0.66
960729	0417	0.78	0.064	15.6	172	154	0.84	-1.79	3.06	53	-1.14
960729	0717	0.78	0.064	15.6	178	157	0.81	-1.86	3.29	49	-0.91
960729	1317	0.80	0.064	15.6	174	156	0.85	-2.21	3.23	45	-1.09
960729	1617	0.85	0.064	15.6	174	146	0.93	-1.62	2.38	102	-1.77
960729	1917	0.82	0.064	15.6	176	140	1.00	-0.98	1.89	114	-1.54
960730	0117	0.83	0.064	15.6	170	131	1.00	-0.89	1.71	119	-1.73
960730	0417	0.85	0.064	15.6	176	118	1.05	-0.31	1.36	126	-0.99
960730	0717	0.85	0.064	15.6	178	116	1.04	-0.09	1.35	122	-0.52
960730	1017	0.85	0.074	13.6	56	107	1.02	0.22	1.40	119	1.02
960730	1317	0.81	0.074	13.6	44	101	1.06	0.35	1.50	121	0.78
960730	1617	0.79	0.074	13.6	42	97	1.04	0.51	1.51	123	1.15
960730	1917	0.84	0.074	13.6	34	81	1.02	1.08	1.84	123	1.37
960730	2217	0.82	0.074	13.6	60	82	0.95	1.22	2.12	106	1.79
960731	0117	0.86	0.162	6.2	52	77	0.91	1.45	2.40	96	1.41
960731	0417	0.85	0.162	6.2	62	78	0.92	1.35	2.28	103	1.28
960731	0717	0.84	0.132	7.6	54	68	0.87	2.13	3.01	54	0.83
960731	1029	0.85	0.132	7.6	48	68	0.90	1.99	2.72	80	1.54
960731	1317	0.90	0.113	8.9	44	66	0.90	2.06	2.77	76	1.30
960731	1615	1.14	0.123	8.2	34	53	0.74	2.77	4.29	37	0.53
960731	1917	1.37	0.103	9.7	48	52	0.65	2.56	5.41	31	0.15
960731	2217	1.57	0.103	9.7	50	53	0.63	2.79	5.88	26	0.09
960801	0117	1.69	0.113	8.9	44	56	0.62	2.05	5.21	31	0.40
960801	0417	1.71	0.123	8.2	40	53	0.58	1.95	5.76	32	0.70

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960801	0717	1.68	0.113	8.9	42	55	0.58	2.20	5.98	32	0.54
960801	1017	1.79	0.113	8.9	40	54	0.65	2.35	5.18	34	0.62
960801	1317	1.74	0.132	7.6	40	54	0.64	2.19	5.13	34	0.52
960801	1617	2.09	0.123	8.2	34	49	0.61	1.74	5.21	37	0.46
960801	1917	2.13	0.132	7.6	34	54	0.57	1.34	5.35	39	0.13
960801	2217	1.96	0.123	8.2	48	52	0.56	1.88	6.12	31	0.15
960802	0117	1.80	0.132	7.6	30	41	0.64	2.07	5.66	26	0.80
960802	0417	1.83	0.113	8.9	34	47	0.58	2.68	6.42	29	0.82
960802	0717	1.65	0.123	8.2	36	49	0.59	3.07	6.69	29	0.63
960802	1017	1.65	0.132	7.6	44	58	0.62	2.19	5.66	35	0.55
960802	1317	1.53	0.132	7.6	44	57	0.65	3.24	5.75	27	0.59
960802	1615	1.68	0.113	8.9	32	49	0.65	2.42	5.54	36	0.58
960802	1915	1.81	0.113	8.9	36	50	0.62	2.90	6.18	31	0.23
960802	2217	1.54	0.113	8.9	50	55	0.68	3.15	5.53	25	0.24
960803	0117	1.92	0.103	9.7	46	54	0.59	3.81	7.59	21	0.38
960803	0417	2.35	0.113	8.9	38	47	0.58	2.04	7.37	25	0.64
960803	0717	2.29	0.113	8.9	44	48	0.51	3.67	9.91	19	0.19
960803	1017	1.96	0.113	8.9	38	46	0.58	3.56	7.80	24	0.34
960803	1317	1.58	0.123	8.2	48	52	0.63	4.18	7.07	17	0.26
960803	1617	1.52	0.123	8.2	46	52	0.67	2.52	5.56	29	0.25
960803	1917	1.79	0.132	7.6	36	47	0.61	2.16	6.33	32	0.26
960803	2217	1.74	0.132	7.6	52	51	0.61	2.81	6.77	26	-0.16
960804	0117	1.86	0.123	8.2	52	52	0.56	2.24	7.19	23	-0.06
960804	0417	1.84	0.132	7.6	46	52	0.58	3.10	7.27	23	0.32
960804	0717	1.52	0.142	7.0	46	62	0.81	3.06	4.02	39	0.57
960804	1017	1.69	0.113	8.9	42	56	0.77	3.27	4.49	35	0.60
960804	1317	1.61	0.123	8.2	50	61	0.77	3.98	4.53	26	0.38
960804	1617	1.49	0.113	8.9	48	63	0.83	3.22	3.85	38	0.70
960804	1917	1.44	0.113	8.9	34	57	0.85	3.27	3.90	45	0.62
960804	2217	1.43	0.113	8.9	40	60	0.91	3.61	3.42	47	0.94
960805	0117	1.33	0.123	8.2	44	69	1.01	2.80	2.57	130	2.23
960805	0417	1.29	0.103	9.7	-174	104	1.12	0.49	1.32	136	1.36
960805	0717	1.31	0.123	8.2	-176	93	1.06	0.93	1.63	131	1.54
960805	1019	1.31	0.132	7.6	56	75	1.00	2.27	2.42	128	1.91
960805	1317	1.13	0.132	7.6	-174	100	1.16	0.70	1.42	138	1.65
960805	1617	1.04	0.132	7.6	-174	96	1.09	0.79	1.59	133	1.40
960805	1917	1.06	0.132	7.6	36	71	1.01	1.93	2.35	123	1.47
960805	2217	0.93	0.142	7.0	32	76	1.05	1.67	2.12	133	1.25
960806	0117	1.05	0.123	8.2	44	79	1.04	1.55	2.01	130	1.76
960806	0417	0.96	0.123	8.2	42	78	1.05	1.44	1.94	131	1.66
960806	0717	0.97	0.132	7.6	36	88	1.09	0.77	1.57	135	1.20
960806	1016	0.91	0.132	7.6	40	84	1.07	1.02	1.76	131	1.35
960806	1317	0.96	0.142	7.0	36	83	1.07	1.10	1.72	132	1.52
960806	1617	0.95	0.142	7.0	40	93	1.10	0.63	1.52	132	1.16
960806	1917	0.98	0.142	7.0	36	91	1.03	0.72	1.69	120	1.16
960806	2217	1.02	0.132	7.6	48	80	0.99	1.07	2.12	105	1.16
960807	0117	1.04	0.123	8.2	34	72	0.95	1.67	2.39	106	1.29
960807	0417	1.08	0.123	8.2	42	73	0.93	1.68	2.44	100	1.51
960807	0717	1.18	0.123	8.2	50	73	0.91	1.82	2.59	92	1.74
960807	1017	1.25	0.113	8.9	42	67	0.89	1.95	2.79	69	1.23
960807	1317	1.38	0.113	8.9	42	62	0.89	2.55	3.10	60	1.42
960807	1617	1.31	0.123	8.2	40	68	0.92	1.98	2.64	93	1.63
960807	1917	1.29	0.113	8.9	46	77	0.98	1.59	2.24	115	1.56
960807	2217	1.22	0.113	8.9	32	78	1.01	1.19	2.02	118	1.23

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960808	0117	1.25	0.064	15.6	36	77	0.98	1.24	2.09	110	1.20
960808	0417	1.24	0.064	15.6	42	88	1.00	0.83	1.78	115	1.21
960808	0717	1.29	0.064	15.6	44	94	0.97	0.54	1.68	111	0.91
960808	1015	1.19	0.064	15.6	46	87	0.98	0.95	1.94	110	1.16
960808	1317	1.18	0.064	15.6	44	87	0.95	0.94	2.01	105	1.06
960808	1617	1.26	0.064	15.6	62	100	0.99	0.57	1.71	112	0.91
960808	1917	1.25	0.064	15.6	56	99	0.97	0.50	1.74	109	0.93
960808	2217	1.35	0.064	15.6	62	98	0.92	0.47	1.78	101	0.90
960809	0117	1.30	0.064	15.6	64	93	0.95	0.77	1.87	103	1.34
960809	0417	1.32	0.064	15.6	52	95	0.94	0.64	1.79	106	1.06
960809	0717	1.38	0.064	15.6	166	103	0.97	0.25	1.51	113	0.74
960809	1017	1.47	0.064	15.6	58	90	0.93	0.82	2.02	100	1.39
960809	1317	1.59	0.142	7.0	48	83	0.93	0.96	2.16	99	1.02
960809	1617	1.61	0.054	18.5	168	105	1.00	0.16	1.50	116	0.48
960809	1917	1.56	0.054	18.5	56	95	0.97	0.64	1.71	112	1.37
960809	2217	1.68	0.064	15.6	168	100	0.95	0.40	1.52	109	1.34
960810	0117	1.76	0.064	15.6	170	95	0.97	0.57	1.57	115	1.29
960810	0417	1.60	0.064	15.6	42	98	1.00	0.33	1.43	119	0.89
960810	0717	1.45	0.064	15.6	164	132	0.90	-1.01	2.10	97	-1.76
960810	1017	1.49	0.064	15.6	166	122	0.95	-0.58	1.62	108	-1.46
960810	1317	1.53	0.064	15.6	170	98	1.03	0.34	1.45	122	0.88
960810	1617	1.50	0.064	15.6	170	111	1.02	-0.03	1.42	120	0.01
960810	2217	1.56	0.064	15.6	170	106	0.95	0.18	1.48	109	0.87
960811	0117	1.49	0.064	15.6	172	105	0.98	0.27	1.52	113	0.99
960811	0417	1.37	0.064	15.6	168	105	1.03	0.08	1.34	122	0.42
960811	0717	1.36	0.064	15.6	170	135	0.97	-1.07	1.87	111	-2.10
960811	1017	1.27	0.064	15.6	168	127	1.00	-0.72	1.65	114	-1.71
960811	1318	1.38	0.064	15.6	172	117	1.04	-0.24	1.35	120	-0.60
960811	1617	1.47	0.064	15.6	174	114	1.07	-0.10	1.29	125	-0.14
960811	1917	1.37	0.064	15.6	170	110	1.02	-0.08	1.35	119	-0.11
960811	2217	1.48	0.064	15.6	174	95	1.03	0.52	1.47	122	1.42
960812	0117	1.61	0.123	8.2	58	81	0.93	1.22	2.10	107	1.62
960812	0417	1.61	0.123	8.2	32	70	0.97	1.89	2.34	119	1.61
960812	0717	1.55	0.123	8.2	48	72	0.98	1.66	2.20	117	2.00
960812	1026	1.61	0.123	8.2	42	62	0.91	2.41	2.85	80	1.63
960812	1317	1.59	0.123	8.2	42	59	0.88	2.66	3.11	53	1.29
960812	1617	1.61	0.123	8.2	28	62	0.95	2.15	2.60	102	1.34
960812	1917	1.44	0.123	8.2	54	69	0.95	1.83	2.38	115	1.58
960812	2217	1.49	0.123	8.2	48	63	0.88	2.48	3.07	50	0.86
960813	0117	1.34	0.123	8.2	54	68	0.89	1.90	2.74	71	1.08
960813	0417	1.36	0.123	8.2	60	67	0.88	2.18	2.97	51	0.62
960813	0717	1.37	0.093	10.7	56	63	0.87	2.64	3.24	41	0.49
960813	1015	1.48	0.093	10.7	58	65	0.82	2.55	3.36	31	0.31
960813	1317	1.41	0.103	9.7	54	60	0.81	2.86	3.85	31	0.19
960813	1617	1.41	0.103	9.7	60	58	0.76	2.44	4.16	35	-0.28
960813	1917	1.43	0.113	8.9	56	59	0.77	2.69	4.17	33	-0.02
960813	2217	1.48	0.123	8.2	60	62	0.72	2.51	4.38	29	-0.03
960814	0117	1.57	0.123	8.2	58	60	0.69	2.58	4.76	32	0.03
960814	0417	1.71	0.123	8.2	54	57	0.62	2.53	5.75	28	0.05
960814	0717	1.67	0.123	8.2	52	53	0.64	2.34	5.47	32	0.00
960814	1018	1.66	0.123	8.2	48	56	0.68	2.53	4.86	30	0.32
960814	1317	1.64	0.123	8.2	42	52	0.64	1.97	5.12	35	0.21
960814	1617	1.61	0.123	8.2	34	53	0.61	2.15	5.91	34	0.05
960814	1915	1.46	0.123	8.2	56	52	0.62	2.26	5.83	33	-0.20

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960814	2217	1.36	0.123	8.2	44	52	0.66	3.00	5.55	28	0.27
960815	0117	1.31	0.123	8.2	44	52	0.63	2.79	5.77	27	0.39
960815	0417	1.26	0.123	8.2	40	55	0.64	2.50	5.34	33	0.51
960815	0717	1.44	0.123	8.2	36	51	0.58	2.25	6.25	31	0.32
960815	1017	1.38	0.132	7.6	52	55	0.63	2.59	5.78	28	0.11
960815	1317	1.34	0.132	7.6	44	51	0.61	2.47	6.04	30	0.28
960815	1617	1.37	0.083	12.0	40	52	0.64	2.27	5.62	34	0.55
960815	1917	1.43	0.083	12.0	54	56	0.65	2.16	5.59	32	-0.01
960815	2217	1.40	0.083	12.0	56	60	0.74	3.44	5.07	25	0.14
960816	0117	1.15	0.113	8.9	44	56	0.76	3.92	4.86	27	0.63
960816	0417	1.18	0.093	10.7	48	61	0.83	4.63	4.23	28	0.70
960816	0717	1.36	0.103	9.7	50	61	0.83	4.04	4.10	31	0.55
960816	1017	1.38	0.103	9.7	44	56	0.81	4.12	4.46	33	0.88
960816	1317	1.23	0.103	9.7	42	68	0.95	2.02	2.85	70	1.06
960816	1617	1.08	0.113	8.9	42	65	0.88	2.73	3.36	56	1.18
960816	1917	1.26	0.123	8.2	44	59	0.74	3.13	4.84	35	0.46
960816	2217	1.32	0.113	8.9	48	62	0.81	3.64	4.20	33	0.53
960817	0117	1.21	0.113	8.9	52	67	0.82	3.28	3.85	31	0.74
960817	0417	1.04	0.113	8.9	44	66	0.85	2.27	3.38	48	0.96
960817	0717	1.21	0.113	8.9	42	65	0.87	2.55	3.26	52	1.14
960817	1017	1.33	0.113	8.9	50	64	0.78	3.02	4.11	30	0.68
960817	1317	1.30	0.113	8.9	50	65	0.79	2.48	3.76	37	0.86
960817	1617	1.23	0.113	8.9	44	70	0.78	1.81	3.51	49	0.57
960817	1917	1.28	0.113	8.9	42	63	0.71	1.80	4.25	41	0.29
960817	2217	1.39	0.113	8.9	48	58	0.72	2.05	4.18	40	0.38
960818	0117	1.41	0.113	8.9	46	62	0.71	1.77	4.11	38	0.58
960818	0417	1.45	0.113	8.9	40	58	0.67	2.07	4.58	36	0.76
960818	0717	1.54	0.113	8.9	42	57	0.62	1.97	5.16	34	0.51
960818	1017	1.87	0.103	9.7	38	54	0.58	1.71	5.76	34	0.29
960818	1317	1.99	0.103	9.7	46	53	0.55	2.37	6.88	24	0.29
960818	1617	1.93	0.103	9.7	38	52	0.57	1.67	5.41	36	1.03
960818	1917	1.83	0.113	8.9	36	51	0.56	1.65	5.67	36	0.76
960818	2217	1.55	0.103	9.7	34	53	0.63	1.56	5.13	39	0.22
960819	0117	1.58	0.103	9.7	50	57	0.61	2.00	5.74	29	0.22
960819	0417	1.66	0.103	9.7	44	52	0.54	3.09	7.78	19	0.59
960819	0717	1.70	0.103	9.7	48	60	0.57	1.75	6.13	30	0.40
960819	1029	1.92	0.103	9.7	42	52	0.55	1.79	6.95	29	0.54
960819	1317	1.92	0.103	9.7	46	51	0.56	2.04	7.24	25	0.20
960819	1617	1.66	0.103	9.7	46	54	0.55	2.35	7.56	24	0.30
960819	1915	1.63	0.103	9.7	38	54	0.57	1.85	6.13	34	0.58
960819	2217	1.68	0.103	9.7	36	56	0.57	1.60	5.75	37	0.18
960820	0117	1.56	0.113	8.9	50	57	0.59	1.89	5.65	32	0.14
960820	0417	1.64	0.113	8.9	50	57	0.56	1.88	6.61	28	0.18
960820	0717	1.95	0.142	7.0	40	52	0.52	1.78	6.80	31	0.23
960820	1017	1.79	0.132	7.6	56	55	0.50	1.87	7.87	25	-0.05
960820	1317	1.63	0.132	7.6	54	55	0.57	1.83	6.55	30	0.00
960820	1617	1.68	0.132	7.6	40	52	0.55	1.62	6.40	31	0.13
960820	1917	1.70	0.132	7.6	58	53	0.55	1.53	5.90	33	-0.06
960820	2217	1.66	0.132	7.6	60	53	0.55	1.53	6.02	34	0.00
960821	0117	1.65	0.132	7.6	62	57	0.55	1.56	6.46	29	-0.20
960821	0417	1.80	0.132	7.6	58	55	0.50	1.73	7.56	29	-0.27
960821	0717	1.92	0.123	8.2	50	53	0.46	1.91	8.40	23	0.03
960821	1017	1.94	0.123	8.2	52	53	0.52	2.03	7.83	24	0.03

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	A
960821	1317	1.82	0.123	8.2	56	51	0.50	1.96	7.90	26	-0.13
960821	1617	1.84	0.132	7.6	54	53	0.52	2.12	7.78	23	-0.07
960821	1917	1.81	0.123	8.2	52	53	0.51	1.53	6.97	27	-0.05
960821	2217	1.93	0.123	8.2	56	56	0.54	1.85	6.47	24	-0.11
960822	0117	1.86	0.123	8.2	56	56	0.52	2.52	7.57	21	-0.05
960822	0417	1.77	0.123	8.2	56	59	0.58	2.85	6.73	22	0.03
960822	0717	2.16	0.113	8.9	50	54	0.51	3.06	8.35	20	0.11
960822	1018	2.13	0.113	8.9	48	54	0.56	3.40	7.39	20	0.22
960822	1317	2.08	0.113	8.9	50	55	0.58	3.23	7.03	20	0.18
960822	1617	2.08	0.113	8.9	56	57	0.61	3.18	6.29	23	-0.11
960822	1917	2.01	0.113	8.9	54	62	0.63	2.67	5.59	25	0.31
960822	2217	1.90	0.123	8.2	54	64	0.61	2.42	5.50	27	0.21
960823	0417	1.45	0.123	8.2	54	72	0.80	2.36	3.36	41	0.95
960823	0717	1.33	0.074	13.6	58	74	0.84	2.24	3.10	49	1.20
960823	1317	1.42	0.123	8.2	54	68	0.80	2.69	3.67	36	0.69
960823	1617	1.42	0.123	8.2	56	67	0.79	2.29	3.73	41	0.42
960823	1917	1.24	0.123	8.2	64	81	0.90	1.72	2.62	76	1.26
960823	2217	1.26	0.132	7.6	62	76	0.81	2.14	3.23	44	0.82
960824	0117	1.25	0.123	8.2	56	73	0.84	2.50	3.19	48	1.17
960824	0417	1.16	0.074	13.6	54	73	0.89	2.05	2.85	71	1.54
960824	0717	1.08	0.074	13.6	52	83	0.95	1.26	2.13	107	1.40
960824	1017	1.04	0.074	13.6	56	83	0.94	1.31	2.18	108	1.38
960824	1317	1.00	0.074	13.6	56	81	0.95	0.88	2.21	96	0.87
960824	1617	1.03	0.132	7.6	38	72	0.90	1.83	2.70	71	0.89
960824	1917	0.91	0.074	13.6	54	78	0.94	1.73	2.54	90	1.48
960824	2217	0.97	0.074	13.6	48	77	0.92	1.53	2.52	83	1.12
960825	0117	1.03	0.083	12.0	60	71	0.87	1.90	3.04	50	0.76
960825	0717	0.86	0.083	12.0	48	74	0.87	1.35	2.65	70	0.84
960825	1017	0.87	0.083	12.0	48	82	0.88	1.15	2.37	89	1.09
960825	1317	0.81	0.083	12.0	50	71	0.82	1.77	3.08	54	0.86
960825	1617	0.82	0.083	12.0	48	69	0.82	1.96	3.27	50	0.76
960825	1917	0.86	0.083	12.0	54	70	0.79	1.91	3.43	43	0.79
960825	2217	0.80	0.083	12.0	56	72	0.80	1.82	3.33	46	0.77
960826	0117	0.87	0.093	10.7	52	67	0.72	1.87	4.12	36	0.49
960826	0417	0.93	0.093	10.7	48	62	0.66	2.13	4.88	33	0.32
960826	0717	0.94	0.093	10.7	48	62	0.68	2.27	4.65	33	0.45
960826	1017	0.88	0.093	10.7	50	63	0.69	2.16	4.47	33	0.56
960826	1317	0.86	0.093	10.7	50	71	0.71	1.40	3.75	46	0.50
960826	1617	0.85	0.093	10.7	34	48	0.76	1.60	4.09	38	1.17
960826	2217	0.82	0.093	10.7	48	67	0.79	1.88	3.46	44	0.69
960827	0117	0.85	0.113	8.9	46	75	0.75	1.40	3.32	47	0.11
960827	0417	0.87	0.103	9.7	64	80	0.81	1.46	2.80	58	0.79
960827	0717	0.82	0.123	8.2	58	81	0.85	1.33	2.53	75	1.12
960827	1016	0.91	0.162	6.2	58	74	0.79	1.68	3.35	45	0.87
960827	1317	1.12	0.162	6.2	52	74	0.76	1.18	3.32	50	0.36
960827	1617	1.41	0.152	6.6	76	67	0.65	1.06	4.01	44	-0.05
960827	1917	1.62	0.152	6.6	58	57	0.65	1.26	4.37	42	0.00
960827	2218	1.40	0.152	6.6	50	57	0.72	1.85	4.17	41	0.24
960828	0117	1.42	0.152	6.6	38	69	0.82	1.27	2.86	60	0.21
960828	0417	1.46	0.142	7.0	72	71	0.69	1.73	4.11	39	0.02
960828	0717	1.45	0.142	7.0	56	67	0.78	2.01	3.54	45	0.33
960828	1018	1.19	0.142	7.0	50	72	0.86	1.67	2.82	64	0.90
960828	1317	1.04	0.064	15.6	46	91	1.01	0.87	1.82	119	1.13

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960828	1617	0.94	0.064	15.6	56	111	0.98	0.31	1.52	114	0.78
960828	1917	0.94	0.064	15.6	70	106	0.95	0.45	1.69	103	1.25
960828	2217	1.17	0.074	13.6	70	95	0.88	1.08	2.17	94	1.91
960829	0117	1.52	0.142	7.0	74	81	0.76	1.56	3.40	34	0.42
960829	0417	1.42	0.142	7.0	66	81	0.80	1.92	3.20	44	1.09
960829	0717	1.64	0.142	7.0	58	70	0.73	2.38	4.22	33	0.44
960829	1017	1.70	0.103	9.7	56	72	0.69	2.08	4.46	34	0.58
960829	1317	1.83	0.103	9.7	72	77	0.63	1.44	4.88	29	0.18
960829	1617	1.86	0.123	8.2	72	73	0.60	1.51	5.22	31	0.00
960829	1915	1.77	0.113	8.9	76	73	0.66	1.47	4.40	33	-0.22
960829	2217	1.52	0.113	8.9	80	80	0.72	1.56	4.03	34	-0.02
960830	0117	1.48	0.123	8.2	74	78	0.67	1.88	4.67	26	0.10
960830	0417	1.64	0.132	7.6	74	78	0.68	1.79	4.40	31	0.10
960830	0717	1.73	0.142	7.0	70	76	0.70	1.96	4.31	32	0.24
960830	1017	1.79	0.093	10.7	62	73	0.67	1.68	4.55	32	0.42
960830	1317	1.93	0.132	7.6	58	73	0.65	1.72	4.78	35	0.47
960830	1617	1.88	0.132	7.6	54	69	0.64	1.77	5.20	36	0.04
960830	1917	1.77	0.123	8.2	68	71	0.68	2.25	4.79	33	0.05
960830	2217	1.84	0.093	10.7	72	76	0.71	1.77	4.15	32	0.08
960831	0117	2.25	0.123	8.2	64	66	0.61	2.26	6.24	23	0.09
960831	0417	2.41	0.113	8.9	56	64	0.58	2.29	6.45	26	0.35
960831	0717	2.24	0.113	8.9	38	43	0.72	0.64	5.56	20	0.51
960831	1017	1.96	0.113	8.9	56	70	0.84	2.37	3.52	42	0.75
960831	1317	1.99	0.113	8.9	60	71	0.70	2.16	4.47	33	0.31
960831	1917	2.08	0.083	12.0	62	66	0.72	3.47	5.11	24	0.19
960831	2217	1.81	0.083	12.0	60	68	0.73	2.85	4.71	26	0.42
960901	0117	1.77	0.093	10.7	62	71	0.76	2.62	4.29	26	0.49
960901	0417	1.94	0.123	8.2	54	63	0.66	3.20	5.94	22	0.49
960901	0717	1.91	0.093	10.7	52	63	0.74	3.48	4.83	28	0.61
960901	1017	1.60	0.103	9.7	52	71	0.86	2.66	3.32	45	0.94
960901	1317	1.49	0.123	8.2	60	77	0.80	2.41	3.53	36	0.96
960901	1617	1.98	0.103	9.7	54	64	0.68	3.20	5.33	24	0.40
960901	1917	2.02	0.103	9.7	58	63	0.71	3.04	5.06	25	0.23
960901	2217	1.81	0.103	9.7	56	66	0.73	3.25	4.69	23	0.56
960902	0117	1.67	0.103	9.7	56	70	0.79	2.64	3.71	28	0.90
960902	0417	1.72	0.103	9.7	56	71	0.79	2.61	3.70	31	1.03
960902	0717	1.63	0.103	9.7	56	74	0.82	2.35	3.24	46	1.53
960902	1017	1.57	0.103	9.7	52	71	0.88	2.54	3.07	60	1.72
960902	1317	1.52	0.103	9.7	52	83	0.96	1.45	2.13	111	2.06
960902	1617	1.62	0.103	9.7	54	81	0.92	1.68	2.44	104	1.99
960902	2217	1.39	0.093	10.7	54	91	0.99	1.00	1.80	115	1.90
960903	0118	1.45	0.064	15.6	52	91	0.98	0.90	1.73	114	1.84
960903	0417	1.45	0.093	10.7	54	87	0.96	1.16	1.96	111	2.02
960903	0717	1.44	0.064	15.6	50	88	1.00	1.08	1.80	118	1.99
960903	1017	1.49	0.093	10.7	50	82	0.97	1.37	2.06	114	2.11
960903	1317	1.35	0.064	15.6	54	107	1.00	0.23	1.45	114	0.88
960903	2217	1.34	0.064	15.6	50	98	1.03	0.57	1.50	123	1.39
960904	0417	1.21	0.074	13.6	170	111	1.03	0.01	1.45	119	0.14
960904	0717	1.23	0.074	13.6	178	116	1.06	-0.10	1.39	123	0.05
960904	1017	1.18	0.064	15.6	178	118	1.07	-0.08	1.36	124	-0.38
960904	1617	1.19	0.064	15.6	174	132	1.00	-0.71	1.68	114	-1.48
960904	1917	1.20	0.074	13.6	172	136	0.97	-0.88	1.81	111	-1.69

Table A1 (Continued)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960905	0117	1.90	0.132	7.6	46	56	0.77	2.53	3.90	38	0.26
960905	0417	2.17	0.132	7.6	50	54	0.72	2.96	4.59	31	0.05
960905	0717	1.90	0.132	7.6	56	58	0.78	2.03	3.59	41	-0.06
960905	1017	1.77	0.132	7.6	50	61	0.82	2.47	3.47	38	0.71
960905	1317	1.79	0.132	7.6	52	59	0.81	2.61	3.65	38	0.28
960905	1617	1.84	0.132	7.6	54	60	0.76	2.53	4.03	32	0.21
960905	1917	2.01	0.132	7.6	56	62	0.75	2.23	3.92	33	0.24
960905	2217	1.91	0.132	7.6	62	62	0.70	1.87	4.18	36	-0.13
960906	0117	2.01	0.113	8.9	56	58	0.72	2.15	4.45	33	0.05
960906	0417	2.17	0.123	8.2	56	54	0.59	2.37	6.01	27	-0.29
960906	0717	2.10	0.123	8.2	54	56	0.66	2.49	5.16	28	-0.06
960906	1017	2.18	0.113	8.9	50	55	0.66	2.56	5.43	25	0.19
960906	1315	2.00	0.103	9.7	52	58	0.77	2.42	3.99	36	0.27
960906	1917	1.78	0.113	8.9	48	59	0.78	2.83	3.97	32	0.44
960906	2217	1.74	0.113	8.9	56	64	0.78	2.18	3.68	37	0.45
960907	0117	1.64	0.123	8.2	58	64	0.79	2.66	3.86	34	0.30
960907	0417	1.40	0.123	8.2	56	70	0.88	2.16	2.97	54	1.00
960907	0717	1.35	0.113	8.9	56	65	0.83	2.12	3.32	43	0.68
960907	1017	1.51	0.123	8.2	58	63	0.76	2.21	4.25	26	0.29
960907	1317	1.47	0.123	8.2	56	62	0.89	1.08	3.09	52	0.28
960907	1617	1.34	0.123	8.2	60	75	0.90	1.78	2.73	71	1.44
960907	1917	1.43	0.123	8.2	62	70	0.83	1.95	3.33	37	0.46
960907	2217	1.27	0.123	8.2	56	69	0.82	1.92	3.38	42	0.97
960908	0117	1.31	0.123	8.2	62	64	0.85	1.96	3.23	48	-0.05
960908	0717	1.18	0.132	7.6	56	65	0.86	1.93	3.09	50	0.49
960908	1017	1.00	0.132	7.6	66	82	0.95	1.28	2.30	100	1.55
960908	1317	1.04	0.132	7.6	68	77	0.91	1.44	2.58	76	1.14
960908	1617	1.06	0.132	7.6	66	73	0.91	1.47	2.62	70	0.57
960908	1917	1.07	0.054	18.5	64	71	0.89	1.43	2.63	72	0.69
960908	2217	0.98	0.054	18.5	64	75	0.88	1.22	2.65	62	1.00
960909	0117	1.08	0.054	18.5	68	70	0.85	1.36	2.94	49	0.06
960909	0417	1.08	0.132	7.6	66	62	0.86	1.45	2.89	62	0.03
960909	0717	1.09	0.132	7.6	68	63	0.84	1.74	3.23	52	-0.09
960909	1014	0.99	0.064	15.6	58	68	0.88	1.46	2.77	61	0.54
960909	1317	1.15	0.064	15.6	64	66	0.76	1.66	3.72	32	0.01
960909	1917	1.20	0.064	15.6	66	69	0.74	1.83	3.93	29	0.14
960909	2217	1.24	0.064	15.6	56	63	0.65	1.84	5.04	25	0.12
960910	0117	1.39	0.074	13.6	58	63	0.67	1.69	4.51	26	0.03
960910	0417	1.26	0.074	13.6	60	65	0.69	2.07	4.57	23	0.12
960910	0717	1.12	0.074	13.6	62	66	0.73	1.89	4.10	30	0.05
960910	1017	1.21	0.074	13.6	56	60	0.73	1.89	4.12	33	0.11
960910	1317	1.22	0.074	13.6	60	62	0.69	1.45	4.30	33	-0.01
960910	1617	1.25	0.074	13.6	64	66	0.62	1.98	5.24	24	0.03
960910	1917	1.26	0.074	13.6	60	65	0.66	1.73	4.56	29	0.14
960911	0117	1.20	0.083	12.0	60	66	0.67	1.43	4.01	31	0.19
960911	0417	1.16	0.074	13.6	64	70	0.65	1.59	4.46	26	0.20
960911	0717	1.01	0.074	13.6	68	70	0.72	1.43	3.62	33	0.12
960911	1017	1.05	0.083	12.0	56	67	0.77	1.43	3.56	43	0.46
960911	1317	1.11	0.083	12.0	54	69	0.72	1.44	3.59	39	0.36
960911	1617	1.05	0.083	12.0	60	62	0.69	1.34	4.11	37	0.06
960911	1917	1.00	0.083	12.0	64	73	0.77	1.08	2.97	51	0.43
960911	2217	1.00	0.083	12.0	60	74	0.74	1.28	3.17	48	0.66
960912	0117	0.92	0.083	12.0	56	75	0.77	1.35	2.97	54	1.11

Table A1 (Concluded)

Date	Time GMT	H_{mo} m	f_p Hz	T_p sec	θ_p deg	θ_0 deg	σ	γ	δ	Δθ deg	*A*
960912	0417	0.88	0.093	10.7	56	74	0.81	1.21	2.72	65	1.13
960912	0717	0.84	0.093	10.7	70	77	0.83	1.01	2.56	70	0.71
960912	1017	0.78	0.093	10.7	68	86	0.83	0.88	2.53	76	1.34
960912	1317	0.82	0.093	10.7	56	87	0.81	0.76	2.24	83	1.06
960912	1617	0.89	0.093	10.7	56	86	0.87	0.80	2.22	89	1.14
960912	1917	0.83	0.093	10.7	58	83	0.85	1.16	2.38	84	1.53
960912	2218	0.80	0.103	9.7	60	85	0.81	0.99	2.52	78	1.44
960913	0117	0.78	0.093	10.7	64	88	0.82	1.04	2.56	78	1.58
960913	0417	0.89	0.103	9.7	60	78	0.75	1.55	3.31	46	1.04
960913	0717	0.90	0.074	13.6	62	78	0.71	1.59	3.50	36	0.81
960913	1017	1.15	0.083	12.0	62	73	0.59	1.73	5.38	25	0.37
960913	1317	1.57	0.074	13.6	60	69	0.51	1.81	6.85	22	0.55
960913	1617	1.93	0.083	12.0	60	67	0.47	1.69	7.96	19	0.40
960913	1917	1.79	0.083	12.0	60	66	0.50	1.31	6.52	23	0.35
960913	2217	1.68	0.083	12.0	62	67	0.52	1.19	6.58	21	0.36
960914	0117	1.79	0.083	12.0	58	63	0.55	1.07	6.23	23	0.40
960914	0417	1.75	0.083	12.0	56	61	0.48	1.47	7.73	18	0.29
960914	0717	1.52	0.083	12.0	60	63	0.54	1.17	6.30	24	0.25
960914	1017	1.41	0.083	12.0	60	63	0.55	1.06	6.15	24	0.07
960914	1317	1.40	0.093	10.7	60	62	0.55	1.19	5.75	27	0.16
960914	1617	1.39	0.093	10.7	52	58	0.57	1.19	5.24	32	0.21
960914	1917	1.48	0.093	10.7	54	56	0.58	1.16	4.91	36	0.08
960914	2217	1.43	0.093	10.7	52	58	0.59	1.29	5.02	33	0.21
960915	0117	1.40	0.162	6.2	52	59	0.57	1.12	5.31	32	0.14
960915	0417	1.45	0.103	9.7	58	60	0.60	1.04	4.86	36	0.05
960915	0717	1.44	0.162	6.2	50	57	0.58	1.21	4.91	36	0.19
960915	1017	1.35	0.103	9.7	58	62	0.61	1.05	4.67	35	0.10
960915	1317	1.38	0.103	9.7	58	65	0.59	1.42	5.43	28	0.37
960915	1617	1.47	0.103	9.7	58	62	0.55	1.22	5.57	30	0.10
960915	1917	1.44	0.103	9.7	58	57	0.57	1.23	5.48	32	-0.16
960915	2217	1.46	0.103	9.7	54	55	0.56	1.39	5.95	29	0.06
960916	0117	1.98	0.152	6.6	56	53	0.49	0.82	6.23	29	-0.10
960916	0417	2.28	0.142	7.0	56	55	0.64	0.57	4.30	39	-0.12
960916	0717	2.29	0.142	7.0	54	51	0.45	0.96	6.64	28	-0.20
960916	1017	2.17	0.132	7.6	54	53	0.46	0.90	7.72	24	-0.09
960916	1316	2.15	0.093	10.7	50	57	0.48	0.80	6.41	28	0.24
960916	1617	2.44	0.123	8.2	50	55	0.44	0.97	6.94	24	0.24
960916	1917	2.70	0.123	8.2	46	53	0.45	0.58	5.34	31	0.26
960916	2217	2.89	0.083	12.0	54	53	0.41	0.81	7.93	24	-0.04
960917	0117	2.82	0.103	9.7	54	54	0.40	0.90	9.74	19	-0.01
960917	0417	2.64	0.083	12.0	50	52	0.42	1.08	9.22	20	0.07
960917	0717	2.77	0.074	13.6	50	52	0.41	0.99	9.78	18	0.07
960917	1017	2.74	0.074	13.6	52	53	0.42	0.90	9.37	17	0.08
960917	1317	2.88	0.074	13.6	48	51	0.41	1.15	10.48	17	0.11

(Sheet 31 of 31)

Appendix B
Time Series Graphs of Bulk Parameters

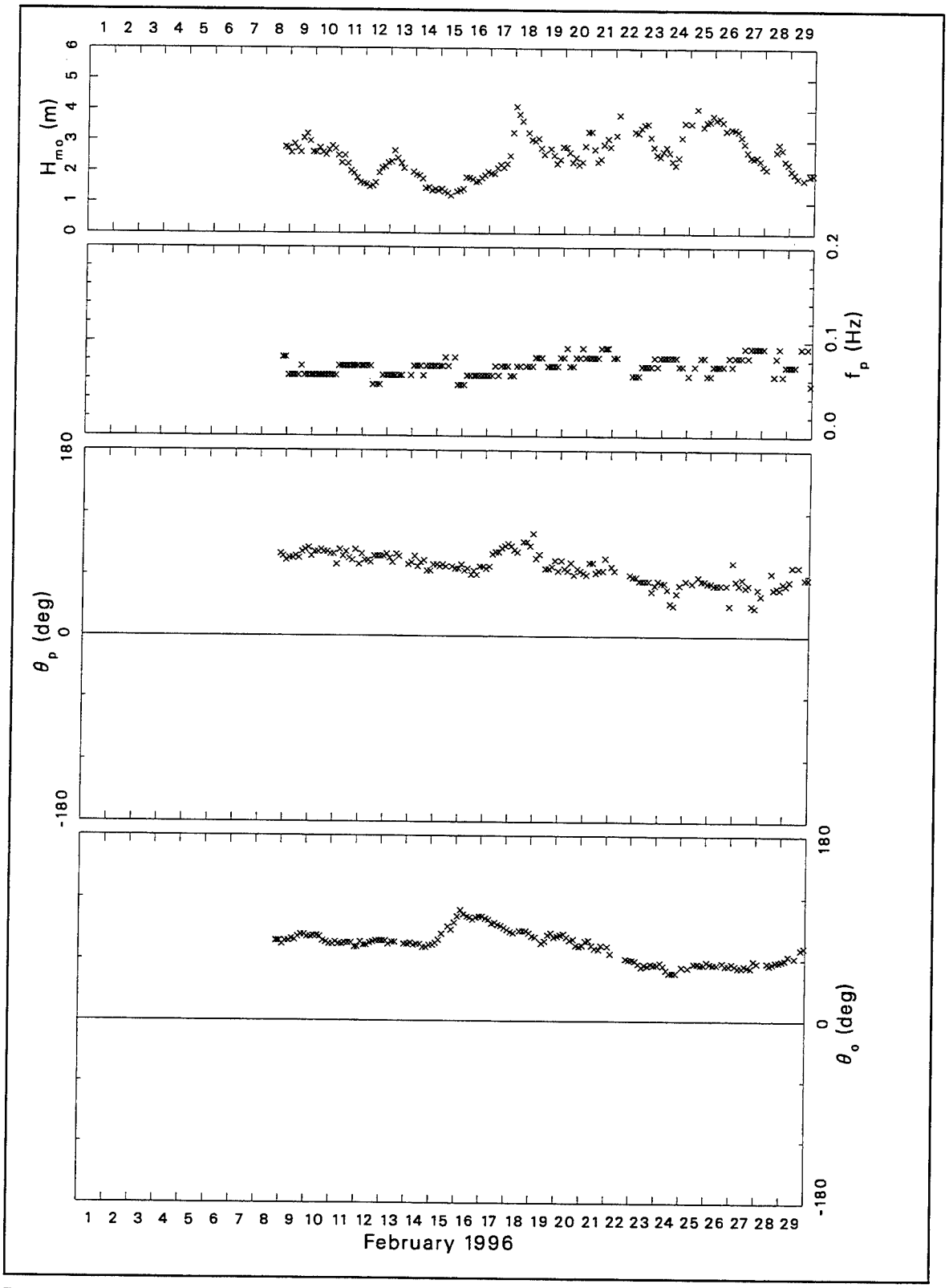

Figure B1. Bulk data for February 1996 (Continued)

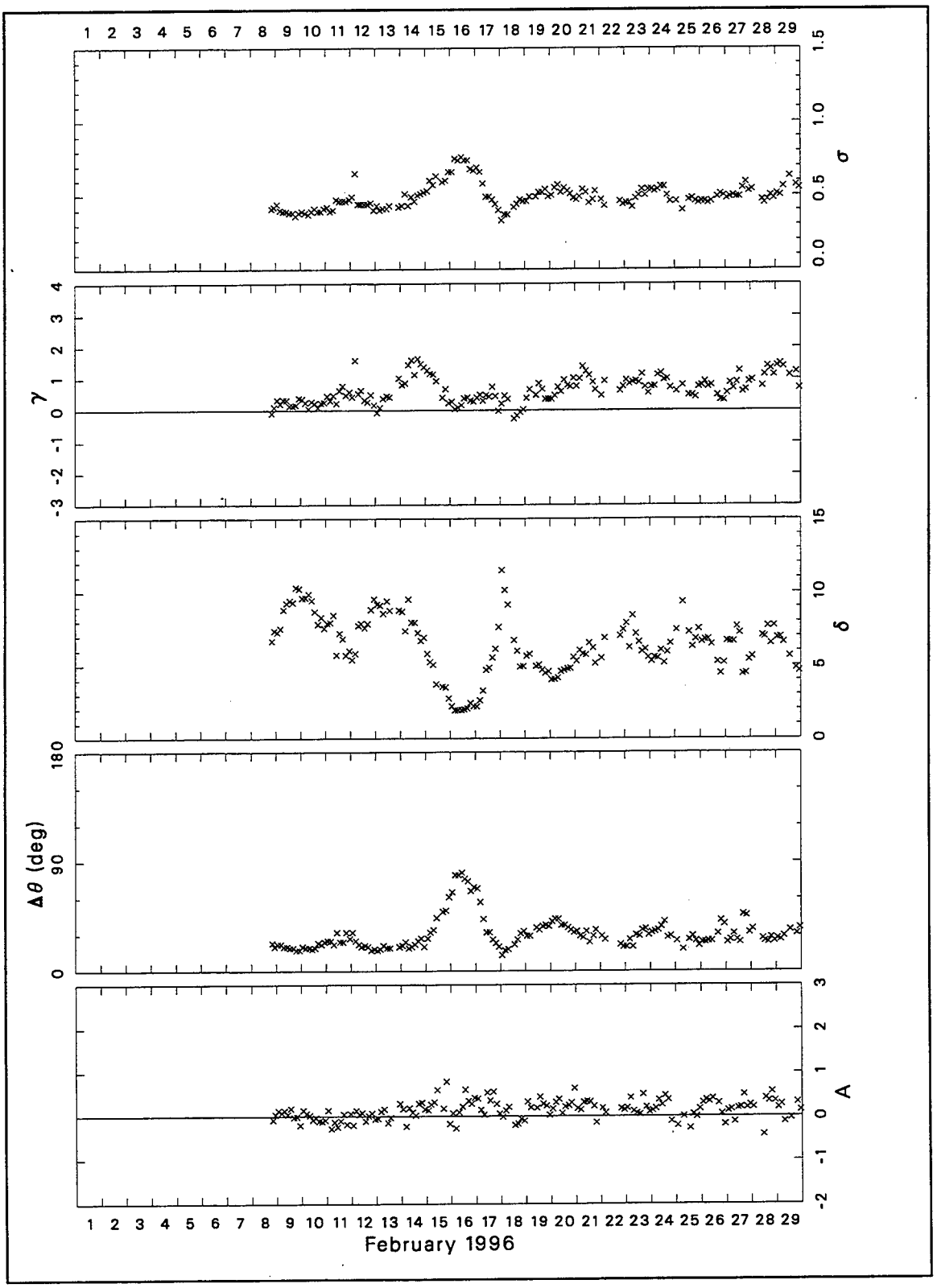

Figure B1. (Concluded)

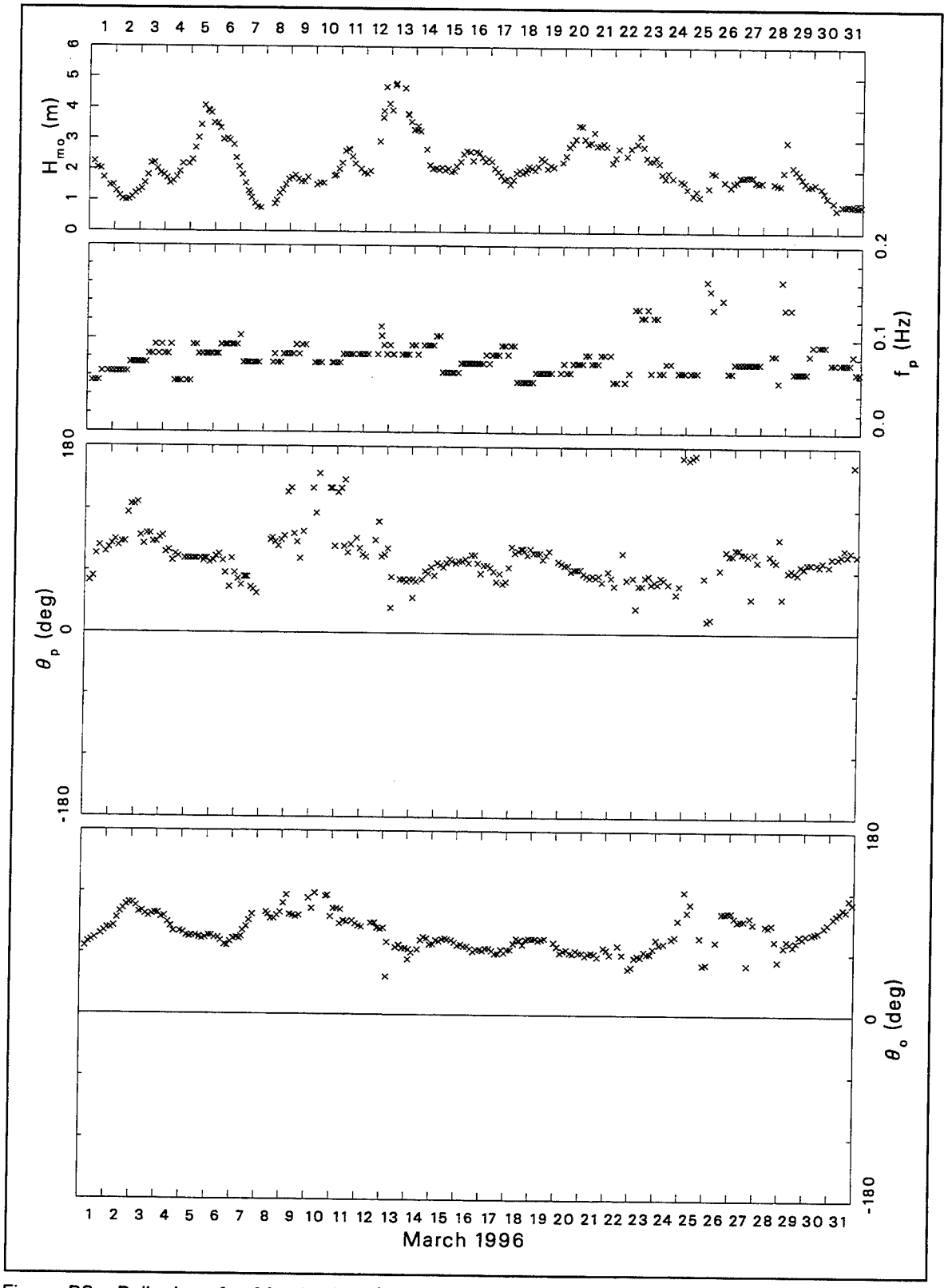

Figure B2. Bulk data for March 1996 (Continued)

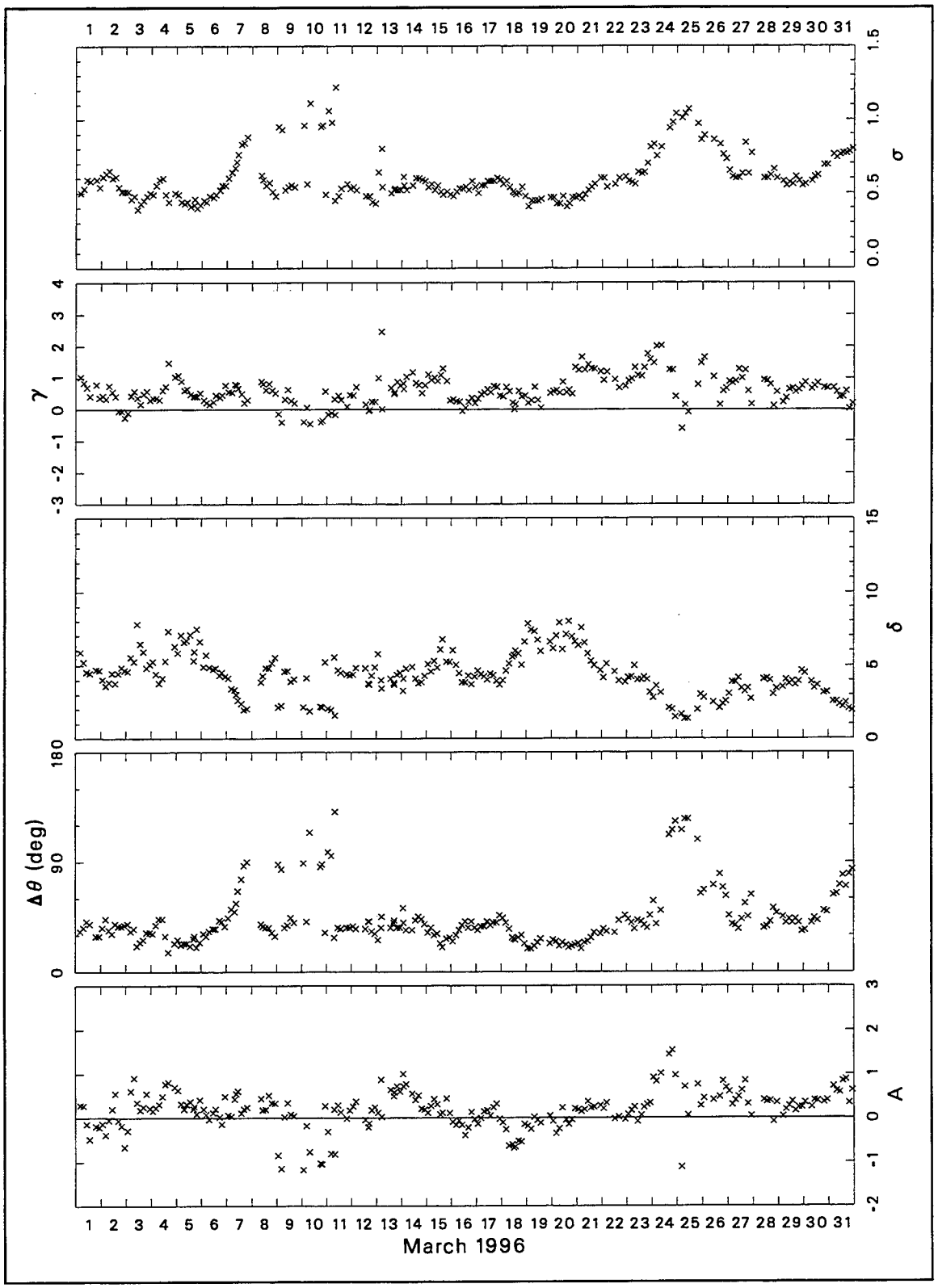

Figure B2. (Concluded)

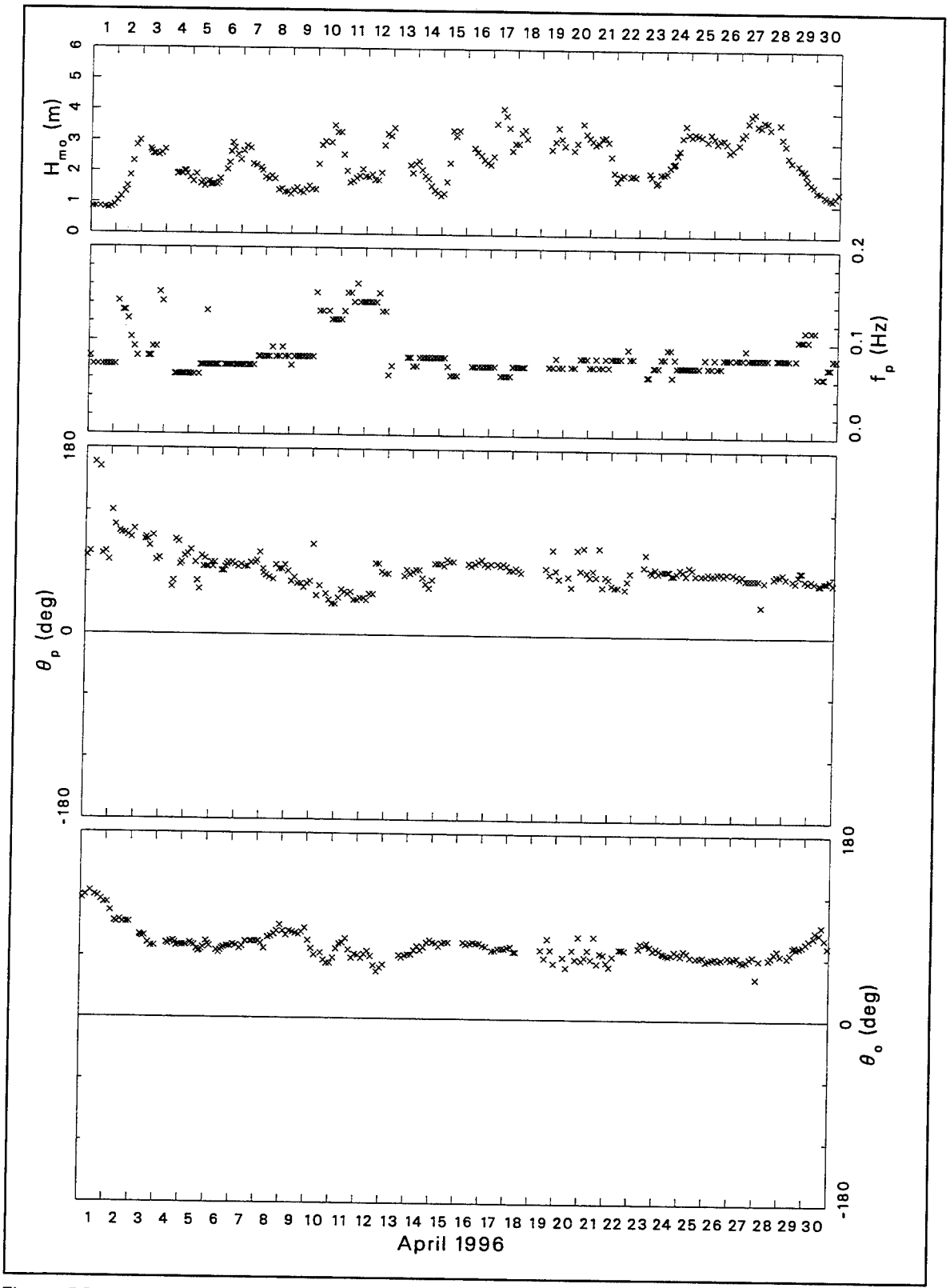

Figure B3. Bulk data for April 1996 (Continued)

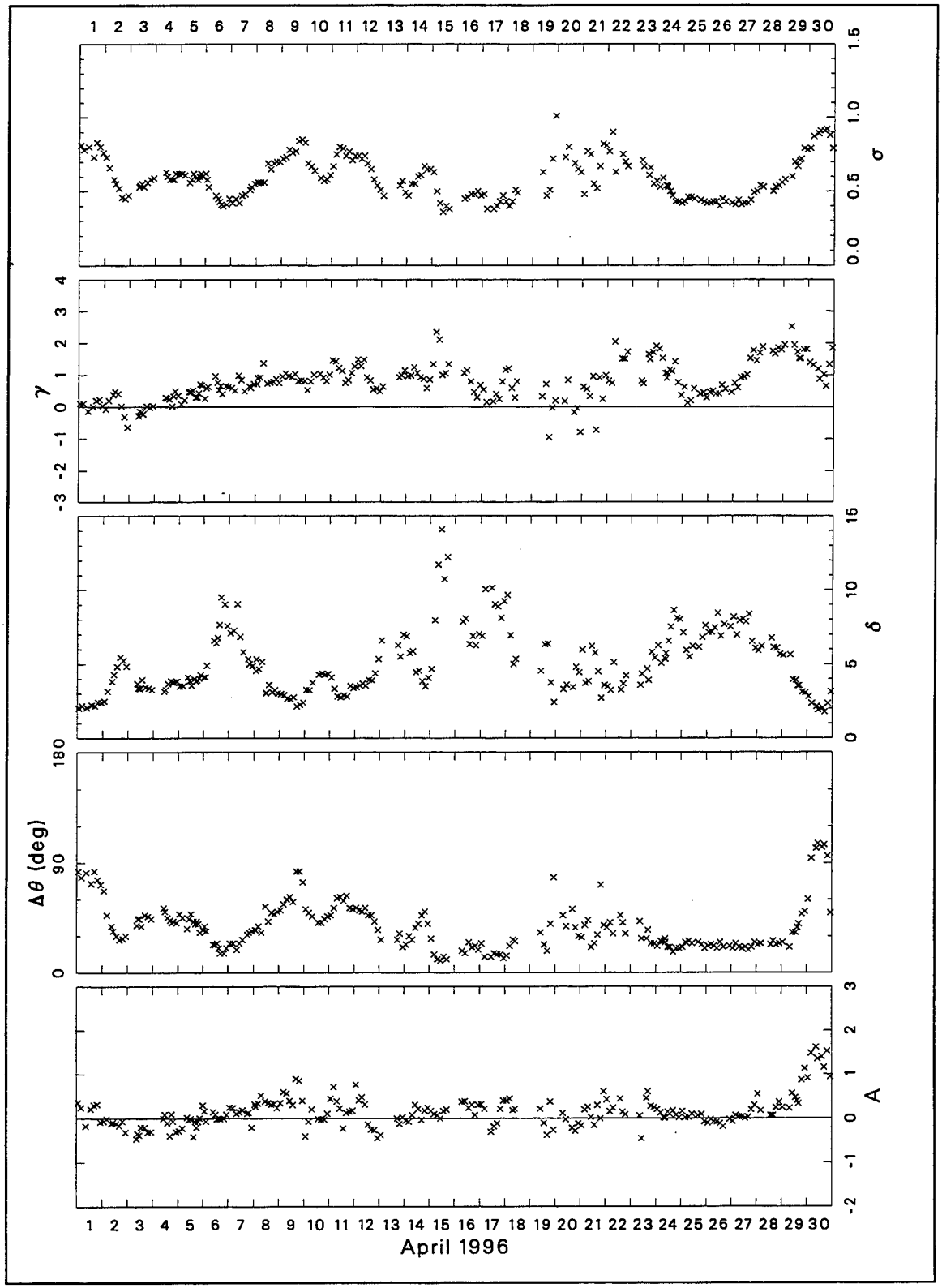

Figure B3. (Concluded)

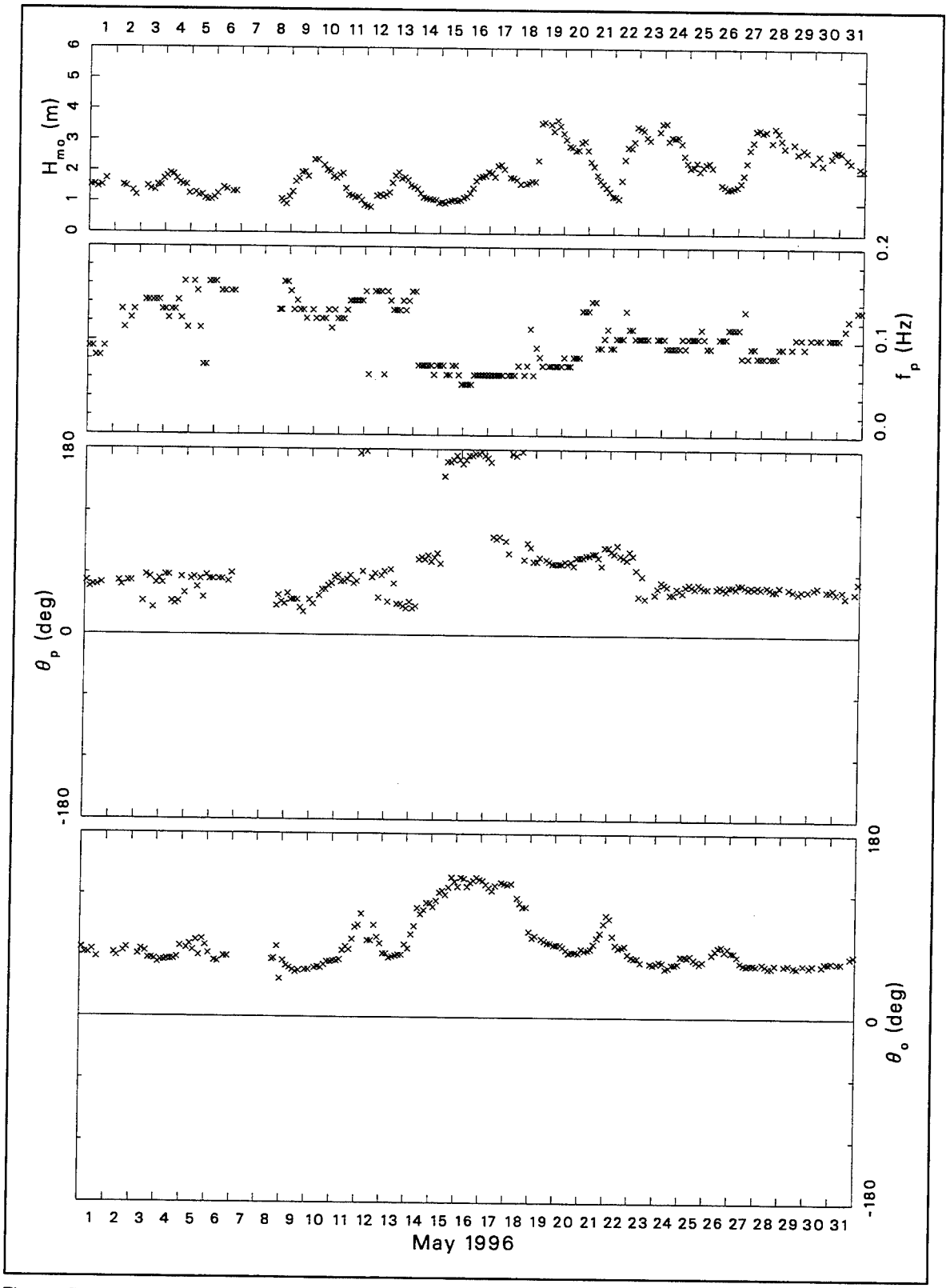

Figure B4. Bulk data for May 1996 (Continued)

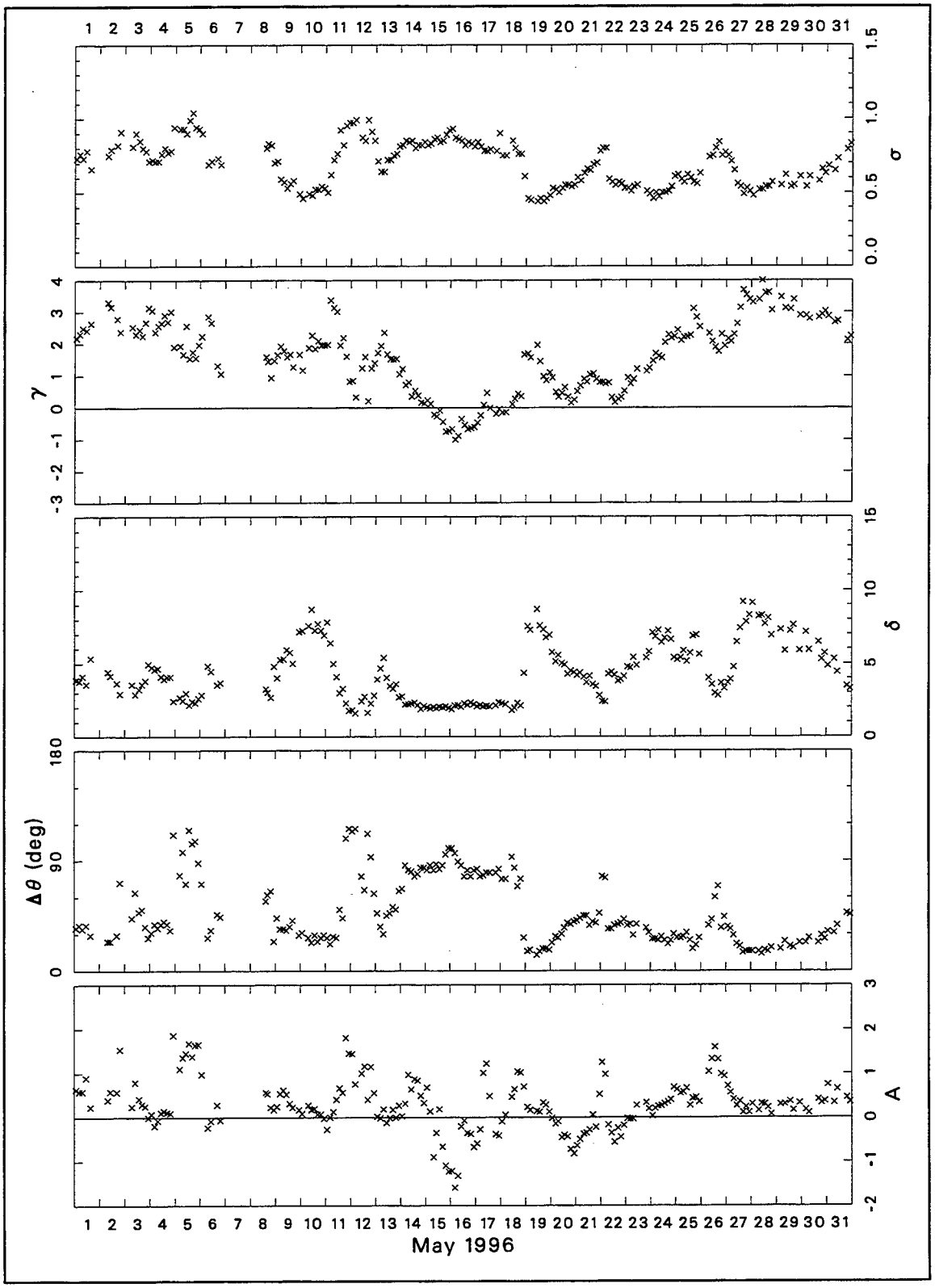

Figure B4. (Concluded)

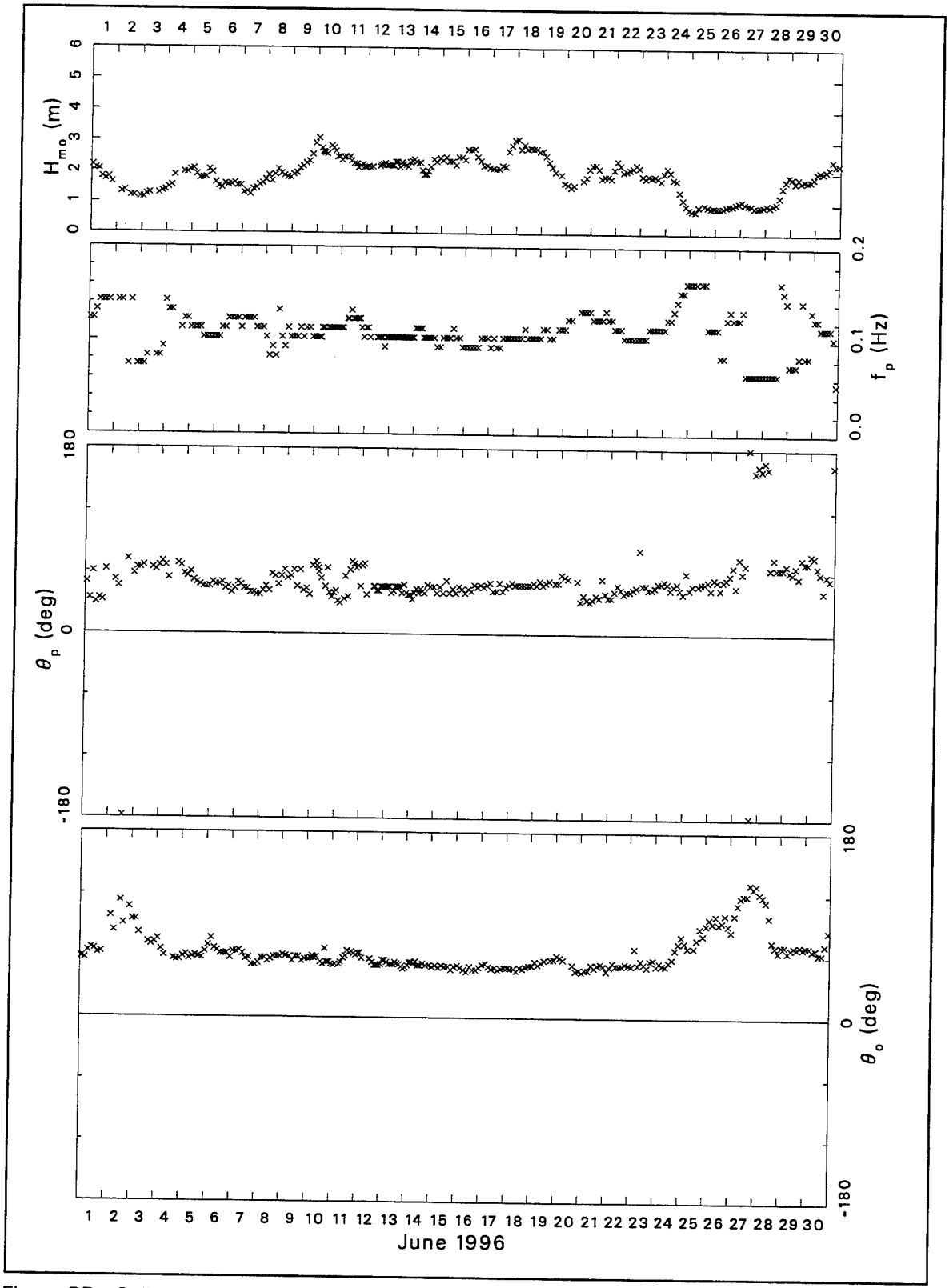

Figure B5. Bulk data for June 1996 (Continued)

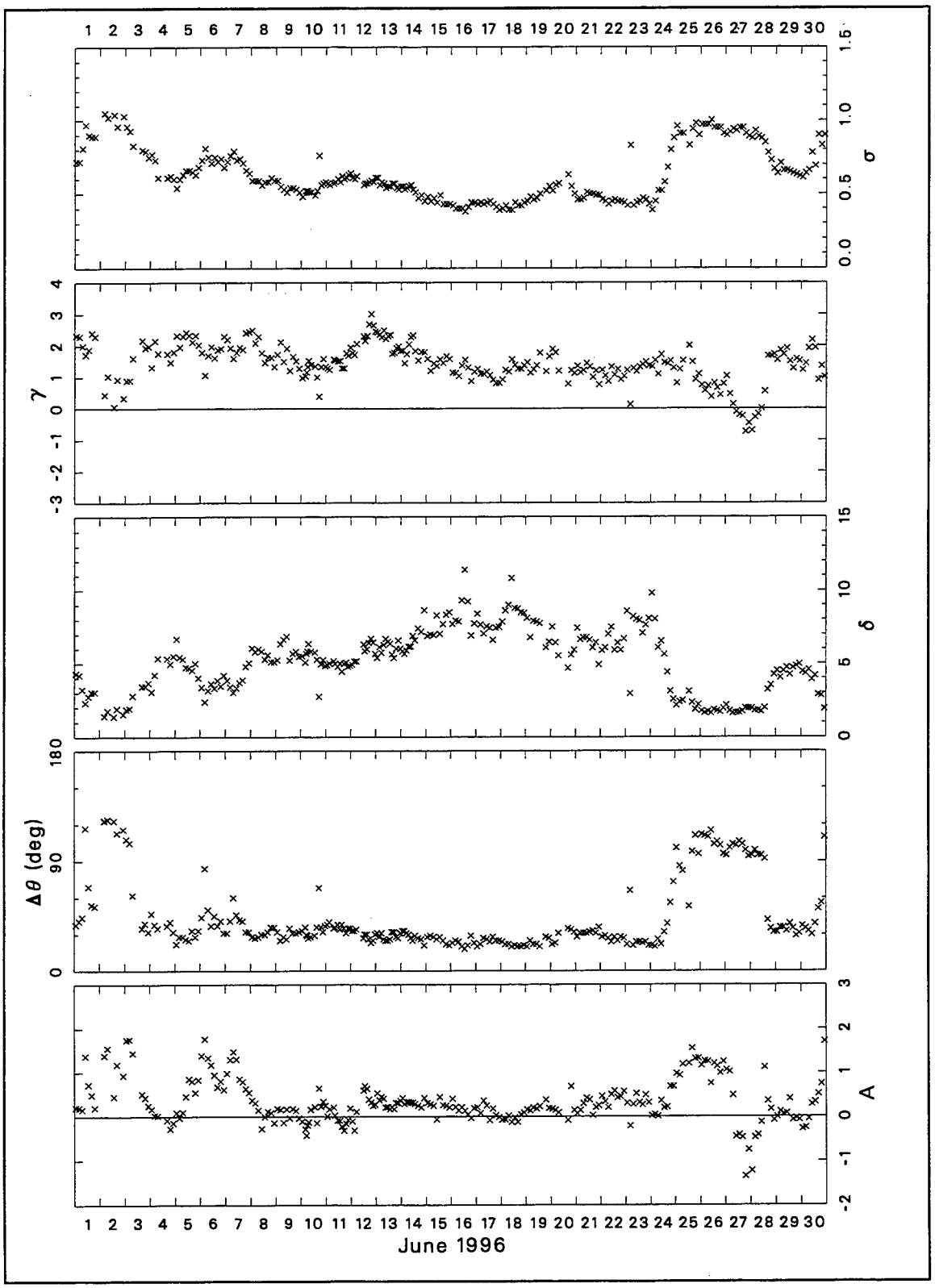

Figure B5. (Concluded)

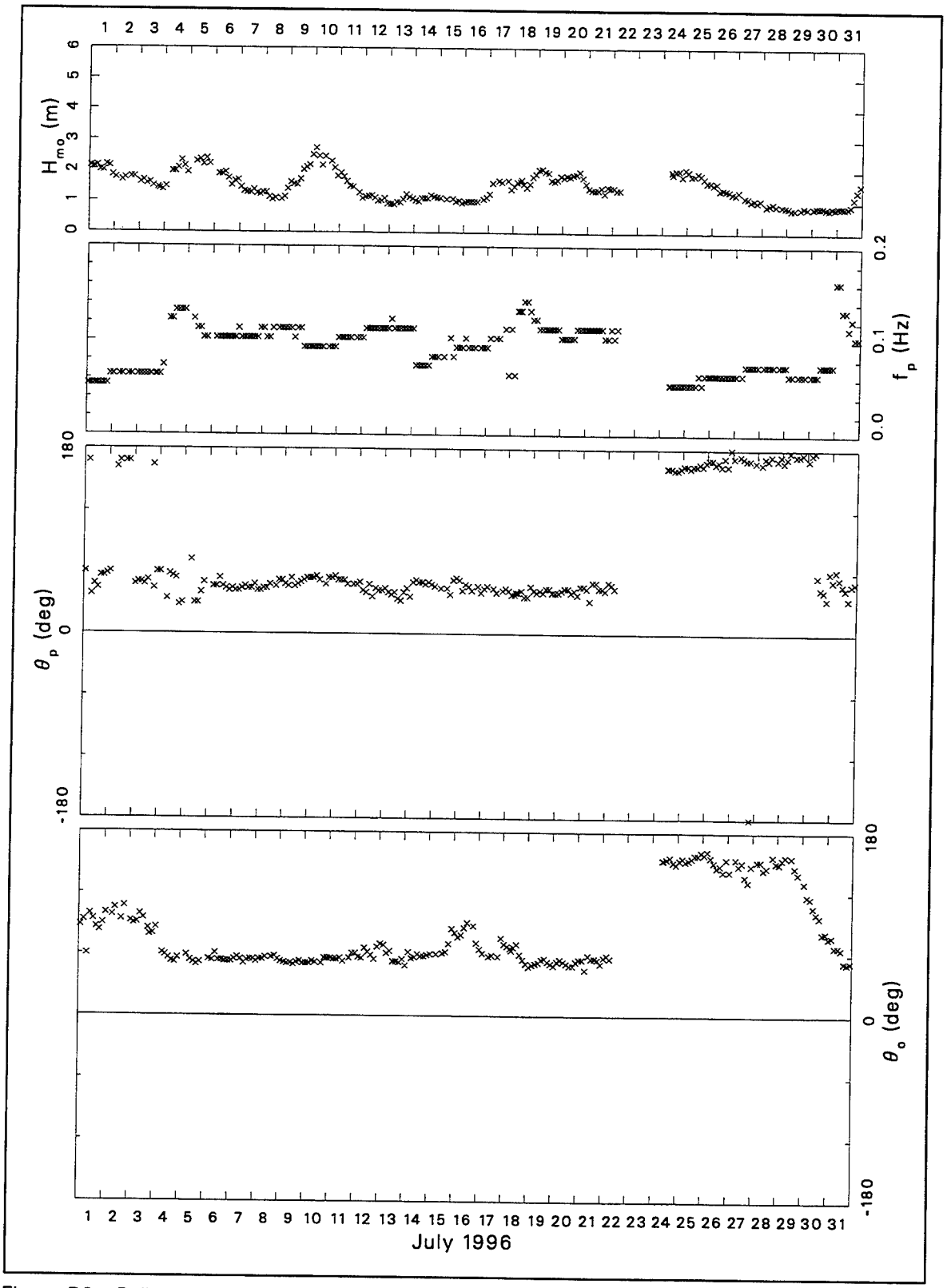

Figure B6. Bulk data for July 1996 (Continued)

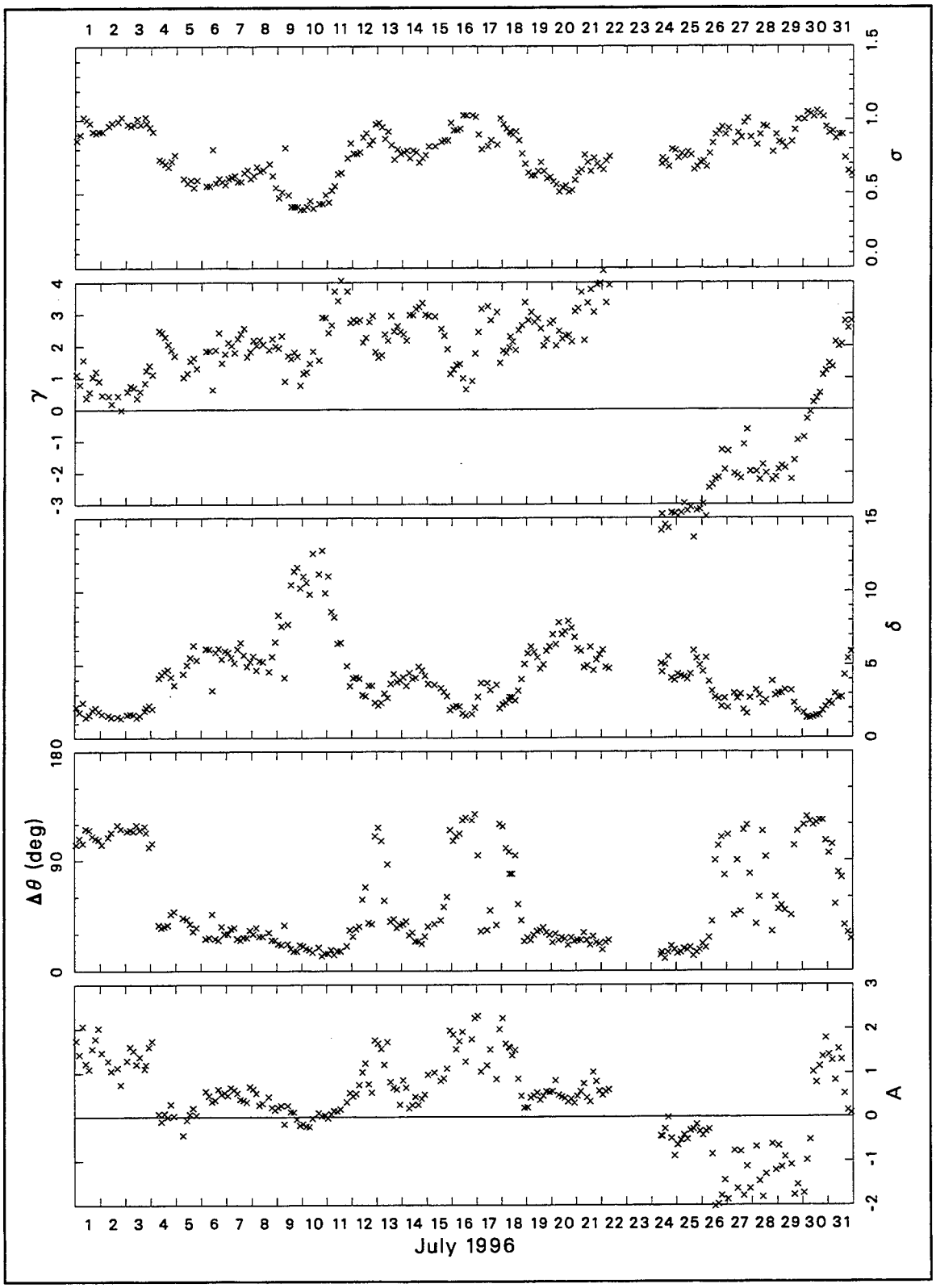

Figure B6. (Concluded)

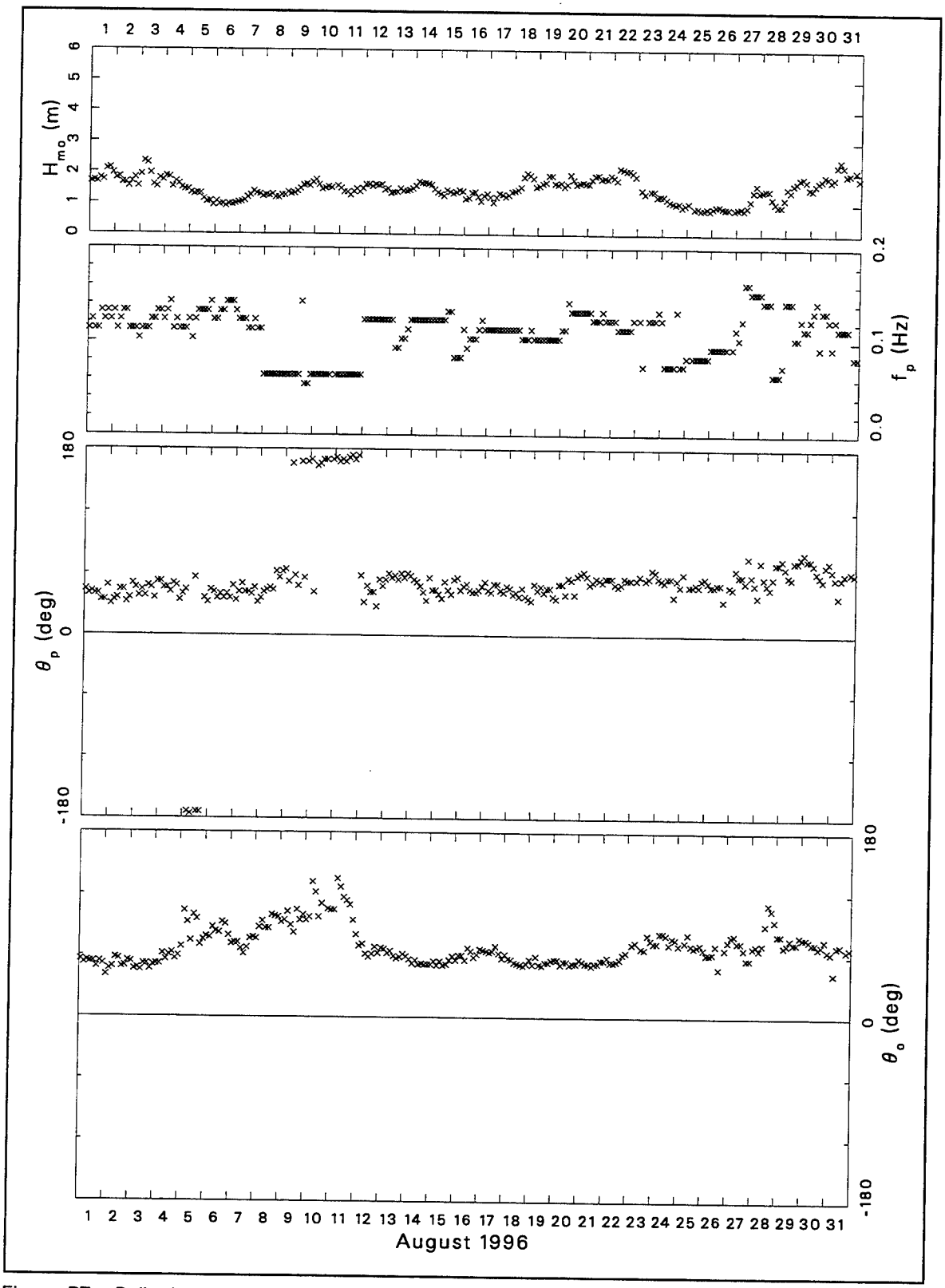

Figure B7. Bulk data for August 1996 (Continued)

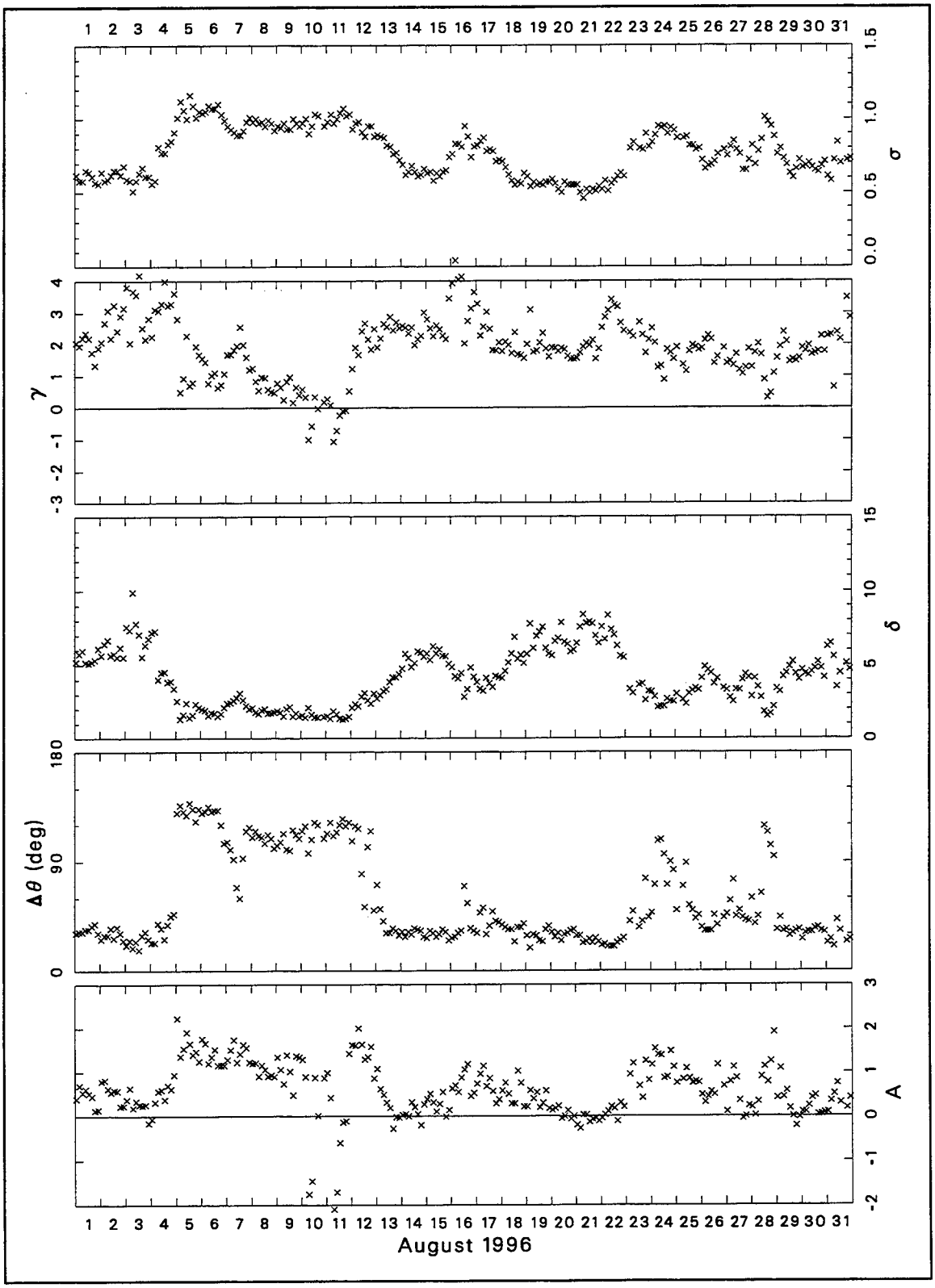

Figure B7. (Concluded)

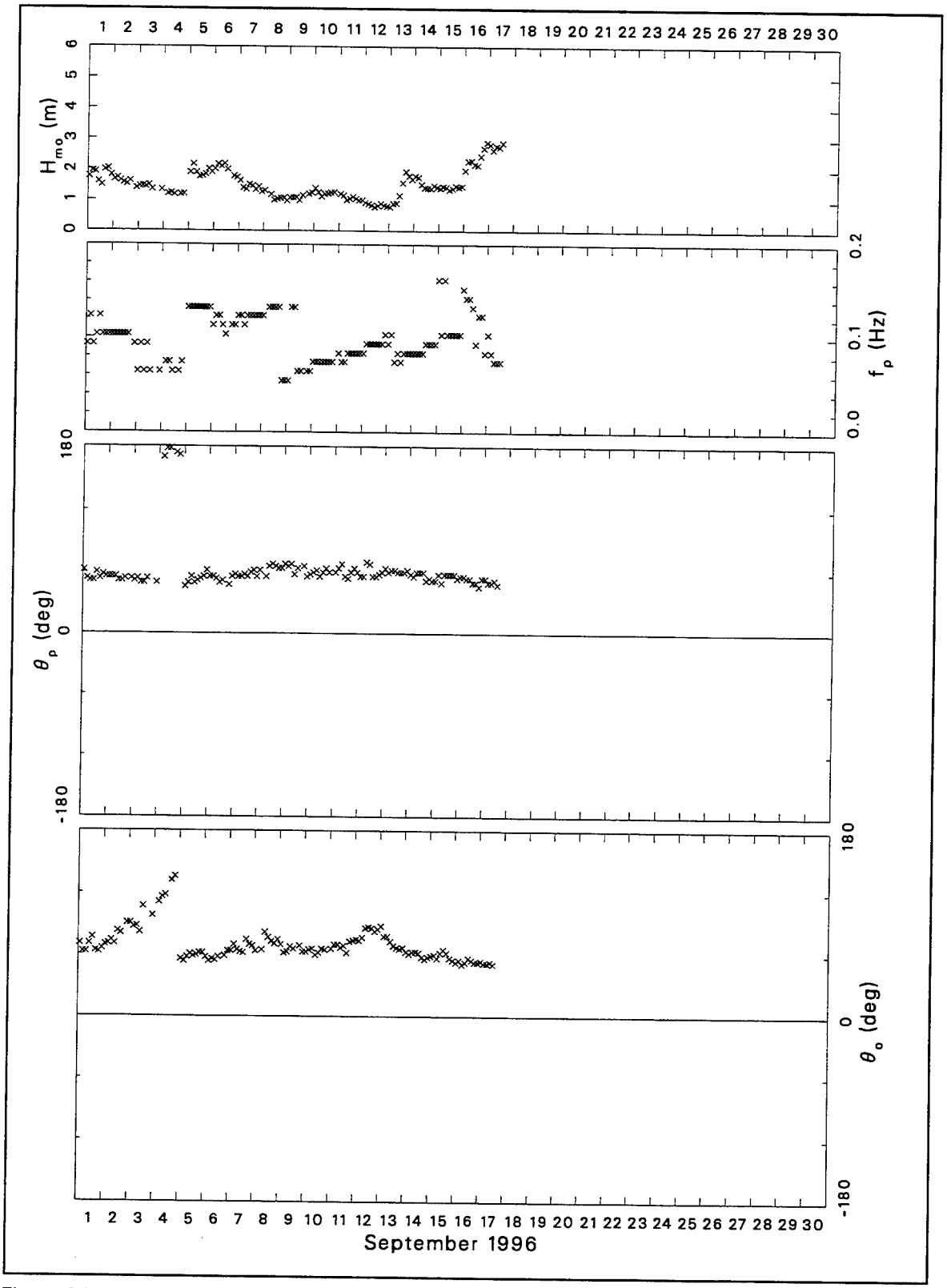

Figure B8. Bulk data for September 1996 (Continued)

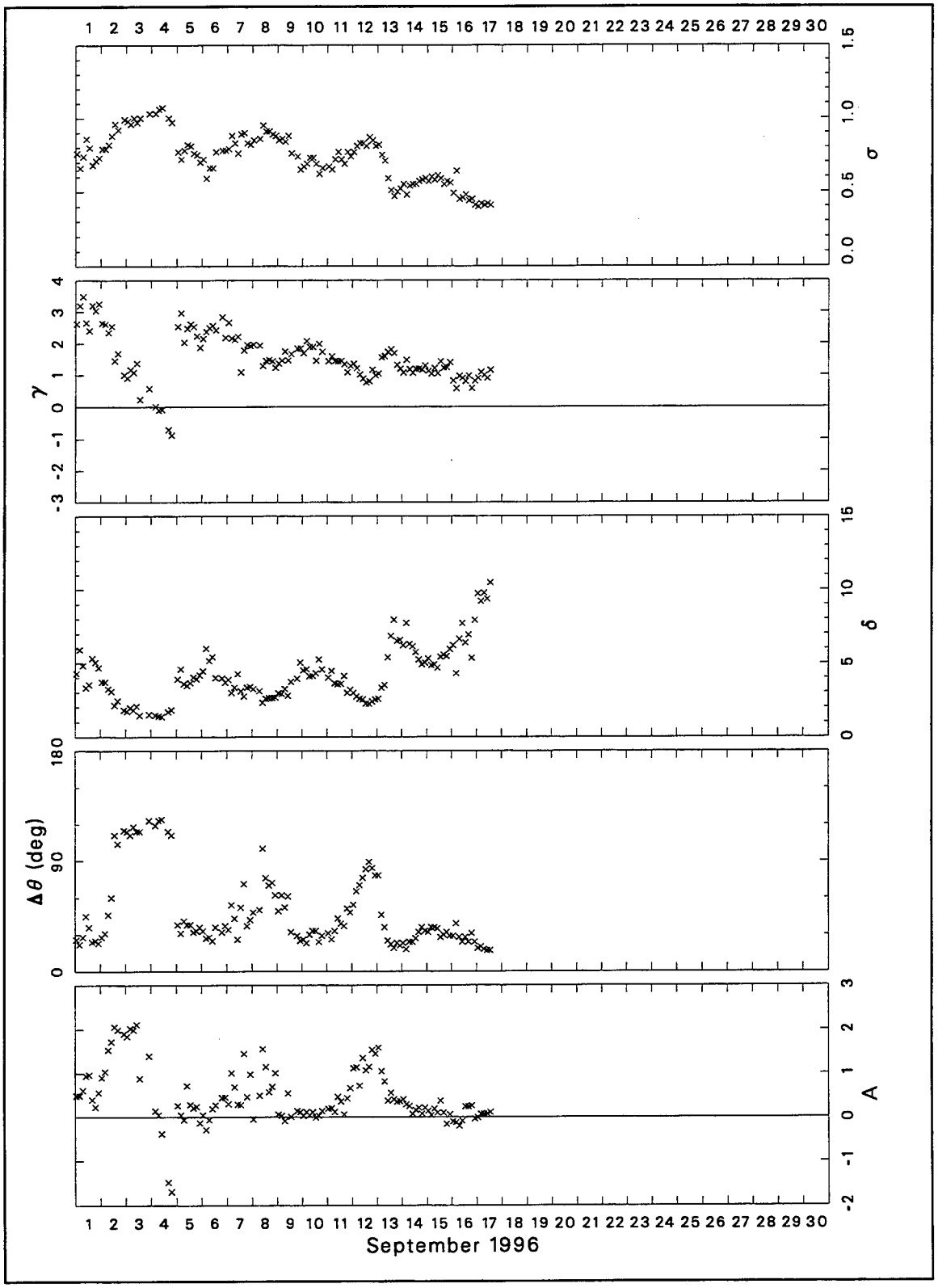

Figure B8. (Concluded)

Appendix C
Listing of FORTRAN Computer Program

```
      program readascii
c
c  Sample FORTRAN program containing statements necessary to read
c  ASCII files of Harvest Platform frequency-direction spectra.
c  This example reads a file called HPyymmddhhmm.ASC, where the
c  string yymmddhhmm is a date/time group entered by the user.
c  In other applications, the I/O statements may need modification
c  to suit a user's system.
c
c  Variable names, units and meanings are:
c
c=====================================================================
c
c      f(nf)..[Hz] frequency at index nf
c  angle(na)..[degrees CCW from true north] direction at index na from
c             which wave energy is arriving
c     sf(nf)..[m^2/Hz] frequency spectral density at f(nf)
c
c ddf(nf,na)..[deg^(-1)] directional distribution function at f(nf)
c             and angle(na), which is the frequency-direction
c             spectral density at f(nf) and angle(na) normalized by
c             sf(nf)
c fds(nf,na)..[m^2/(Hz*deg)] frequency-direction spectrum at f(nf)
c             and angle(na), computed from ddf(nf,na) and sf(nf)
c
c   gpat(nf)..gauge pattern used at f(nf)
c   iter(nf)..# of IMLE iterations for convergence at f(nf)
c   datetime..[character*10] Date and Greenwich Mean Time of
c             beginning of data collection in the order year,
c             month, day, hour, minute, and in the form
c             yymmddhhmm (2-digit year, no blanks in any field)
c
c        Hmo..[m] Energy-based characteristic wave height equal
c             to 4*sigma, where sigma^2 is the variance of sea
c             surface displacement
c         fp..[Hz] frequency at peak of frequency spectrum
c        thp..[deg] direction at peak of directional distribution
c              at f(nf) = fp
c
c     ifimle..algorithm flag: [1]=IMLE estimate, [0]=MLE estimate
c      istot..[sec] duration of data collection
c       sfrq..[Hz] data sampling frequency
```

Figure C1. Listing of FORTRAN Computer Program (Sheet 1 of 3)

```
c    ifwindo..windowing flag: [0]=no windowing of data segments,
c             [1]=segments windowed (Kaiser-Bessel window)
c    ifdtrnd..detrending flag: [0]=no detrending, [1]=linear trend
c             removed from data segments
c       nfft..# of points in each data ensemble
c      nensb..# of half-lapped segments of cross-spectral computations
c      nband..# of raw frequency bands averaged in frequency smoothing
c      idgfr..degrees of freedom in cross-spectral computations
c             (based on contiguous segments only)
c
c       nfrq..number of output frequency bands, equals range of index
c             nf
c      delfs..[Hz] output frequency bandwidth
c       nang..number of output angle bins, equals range of index na
c     delang..[deg] output angle bin width
c
c       dmin..[m] minimum ensemble segment water depth at reference
c             gauge 'rname' during collection
c       dbar..[m] mean water depth at gauge 'rname' during collection
c       dmax..[m] maximum ensemble segment water depth at reference
c             gauge 'rname' during collection
c      rname..[character*5] reference gauge id for depth computations
c
c=======================================================================
c
      character*5         rname
      character*6       gpat(13)
      character*10      indattim,      datetime
      character*80        infile
      dimension           f(13),        sf(13),     iter(13)
      dimension       angle(181),   ddf(13,181),  fds(13,181)
c
c  get file-naming date/time group from user
c
      write(*,'(2x,''Enter date/time group (yymmddhhmm)...'')')
      read(*,'(a10)') indattim                        !date/time string
c
c  define input data file
c
      infile='HP'//indattim(1:10)//'.ASC'
c
c  open, read, and close data file
c
      open(10,file=infile,status='old',form='formatted')
c
      read(10,
     &  '(   a10,   f10.2,   f10.5,  f10.1,     i10,    i10,
     &     f10.5,     i10,/,   i10,    i10,     i10,    i10,
     &       i10,     i10,   f10.5,    i10,/, f10.1,  f10.2,
     &     f10.2,   f10.2,   5x,a5)')
     &  datetime,     Hmo,      fp,    thp,  ifimle,  istot,
     &      sfrq, ifwindo, ifdtrnd,   nfft,   nensb,  nband,
     &     idgfr,    nfrq,   delfs,   nang,  delang,   dmin,
     &      dbar,    dmax,   rname
c
      read(10,'(10f8.1)') (angle(na),na=1,nang)
c
      do 10 nf=1,nfrq
        read(10,
     &    '( i10,   f10.5,   f10.6,    4x,a6,     i10)')
     &         if,   f(nf),  sf(nf), gpat(nf), iter(nf)
        read(10,'(8f10.7)') (ddf(nf,na),na=1,nang)
10    continue
c
      close(10)
```

Figure C1. (Sheet 2 of 3)

```
c
c  compute frequency-direction spectrum fds(nf,na) from ddf(nf,na)
c  and sf(nf)
c
      do 20 nf=1,nfrq
        do 25 na=1,nang
          fds(nf,na)=sf(nf)*ddf(nf,na)
25      continue
20    continue
c
c  at this point, all relevant variables are defined and arrays
c  are loaded;  subsequent computations or operations can be done
c  at the user's discretion...
c
      end
```

Figure C1. (Sheet 3 of 3)

Appendix D
Listing of Sample Data File

```
9606030429      1.24   0.07373      66.0         1      8192   1.00000         1
         0      1024        15        10       160        13   0.00977       181
       2.0    200.84    201.11    201.47     20201
  -180.0  -178.0  -176.0  -174.0  -172.0  -170.0  -168.0  -166.0  -164.0  -162.0
  -160.0  -158.0  -156.0  -154.0  -152.0  -150.0  -148.0  -146.0  -144.0  -142.0
  -140.0  -138.0  -136.0  -134.0  -132.0  -130.0  -128.0  -126.0  -124.0  -122.0
  -120.0  -118.0  -116.0  -114.0  -112.0  -110.0  -108.0  -106.0  -104.0  -102.0
  -100.0   -98.0   -96.0   -94.0   -92.0   -90.0   -88.0   -86.0   -84.0   -82.0
   -80.0   -78.0   -76.0   -74.0   -72.0   -70.0   -68.0   -66.0   -64.0   -62.0
   -60.0   -58.0   -56.0   -54.0   -52.0   -50.0   -48.0   -46.0   -44.0   -42.0
   -40.0   -38.0   -36.0   -34.0   -32.0   -30.0   -28.0   -26.0   -24.0   -22.0
   -20.0   -18.0   -16.0   -14.0   -12.0   -10.0    -8.0    -6.0    -4.0    -2.0
     0.0     2.0     4.0     6.0     8.0    10.0    12.0    14.0    16.0    18.0
    20.0    22.0    24.0    26.0    28.0    30.0    32.0    34.0    36.0    38.0
    40.0    42.0    44.0    46.0    48.0    50.0    52.0    54.0    56.0    58.0
    60.0    62.0    64.0    66.0    68.0    70.0    72.0    74.0    76.0    78.0
    80.0    82.0    84.0    86.0    88.0    90.0    92.0    94.0    96.0    98.0
   100.0   102.0   104.0   106.0   108.0   110.0   112.0   114.0   116.0   118.0
   120.0   122.0   124.0   126.0   128.0   130.0   132.0   134.0   136.0   138.0
   140.0   142.0   144.0   146.0   148.0   150.0   152.0   154.0   156.0   158.0
   160.0   162.0   164.0   166.0   168.0   170.0   172.0   174.0   176.0   178.0
   180.0
         1   0.04443  0.004243      1245        30
 0.0005763 0.0005914 0.0006230 0.0006664 0.0007198 0.0007812 0.0008489 0.0009206
 0.0009941 0.0010670 0.0011373 0.0012027 0.0012612 0.0013111 0.0013509 0.0013797
 0.0013967 0.0014013 0.0013936 0.0013739 0.0013426 0.0013007 0.0012489 0.0011885
 0.0011209 0.0010474 0.0009695 0.0008888 0.0008068 0.0007248 0.0006444 0.0005667
 0.0004929 0.0004240 0.0003605 0.0003031 0.0002520 0.0002072 0.0001688 0.0001362
 0.0001092 0.0000870 0.0000693 0.0000552 0.0000442 0.0000358 0.0000294 0.0000247
 0.0000214 0.0000191 0.0000177 0.0000171 0.0000172 0.0000182 0.0000200 0.0000228
 0.0000270 0.0000329 0.0000411 0.0000522 0.0000670 0.0000865 0.0001118 0.0001441
 0.0001847 0.0002345 0.0002946 0.0003657 0.0004479 0.0005410 0.0006442 0.0007562
 0.0008749 0.0009979 0.0011220 0.0012440 0.0013601 0.0014667 0.0015600 0.0016367
 0.0016937 0.0017286 0.0017397 0.0017265 0.0016890 0.0016286 0.0015476 0.0014492
 0.0013376 0.0012171 0.0010924 0.0009683 0.0008490 0.0007377 0.0006374 0.0005494
 0.0004748 0.0004135 0.0003649 0.0003282 0.0003027 0.0002875 0.0002822 0.0002868
 0.0003016 0.0003276 0.0003661 0.0004188 0.0004878 0.0005753 0.0006833 0.0008133
 0.0009662 0.0011417 0.0013384 0.0015536 0.0017833 0.0020222 0.0022644 0.0025029
 0.0027309 0.0029411 0.0031273 0.0032832 0.0034039 0.0034856 0.0035259 0.0035236
 0.0034790 0.0033942 0.0032722 0.0031176 0.0029361 0.0027345 0.0025198 0.0022997
 0.0020813 0.0018717 0.0016772 0.0015031 0.0013534 0.0012318 0.0011411 0.0010845
 0.0010661 0.0010923 0.0011746 0.0013310 0.0015899 0.0019964 0.0026166 0.0035426
 0.0048923 0.0067957 0.0093684 0.0126537 0.0165598 0.0208089 0.0249272 0.0283124
 0.0303810 0.0307390 0.0293132 0.0263715 0.0224393 0.0181326 0.0139928 0.0103878
 0.0074852 0.0052916 0.0037132 0.0026188 0.0018798 0.0013888 0.0010662 0.0008562
 0.0007219 0.0006391 0.0005926 0.0005729 0.0005714
```

Figure D1. Listing of sample data file (Sheet 1 of 6)

```
        2   0.05420  0.087420     1245          30
0.0093371 0.0091097 0.0088281 0.0085379 0.0082113 0.0078311 0.0073940 0.0069050
0.0063756 0.0058211 0.0052585 0.0047015 0.0041627 0.0036516 0.0031745 0.0027360
0.0023382 0.0019816 0.0016654 0.0013881 0.0011472 0.0009402 0.0007640 0.0006156
0.0004919 0.0003899 0.0003067 0.0002396 0.0001861 0.0001438 0.0001109 0.0000854
0.0000659 0.0000511 0.0000400 0.0000317 0.0000255 0.0000210 0.0000177 0.0000154
0.0000138 0.0000128 0.0000124 0.0000124 0.0000128 0.0000137 0.0000151 0.0000170
0.0000196 0.0000230 0.0000272 0.0000325 0.0000389 0.0000467 0.0000558 0.0000663
0.0000784 0.0000919 0.0001068 0.0001231 0.0001404 0.0001587 0.0001776 0.0001968
0.0002161 0.0002351 0.0002534 0.0002708 0.0002869 0.0003015 0.0003143 0.0003251
0.0003336 0.0003398 0.0003434 0.0003444 0.0003429 0.0003387 0.0003319 0.0003227
0.0003112 0.0002975 0.0002820 0.0002650 0.0002466 0.0002274 0.0002076 0.0001877
0.0001680 0.0001489 0.0001307 0.0001136 0.0000979 0.0000838 0.0000713 0.0000604
0.0000512 0.0000435 0.0000371 0.0000321 0.0000281 0.0000252 0.0000231 0.0000218
0.0000213 0.0000215 0.0000225 0.0000243 0.0000272 0.0000314 0.0000372 0.0000450
0.0000553 0.0000688 0.0000863 0.0001086 0.0001368 0.0001717 0.0002145 0.0002662
0.0003278 0.0003999 0.0004833 0.0005783 0.0006850 0.0008032 0.0009322 0.0010713
0.0012190 0.0013738 0.0015334 0.0016954 0.0018570 0.0020149 0.0021658 0.0023059
0.0024315 0.0025391 0.0026258 0.0026892 0.0027277 0.0027417 0.0027330 0.0027048
0.0026631 0.0026149 0.0025691 0.0025361 0.0025262 0.0025513 0.0026241 0.0027576
0.0029663 0.0032663 0.0036744 0.0042071 0.0048780 0.0056970 0.0066647 0.0077711
0.0089946 0.0103000 0.0116407 0.0129605 0.0141996 0.0152946 0.0161868 0.0168241
0.0171694 0.0172027 0.0169254 0.0163660 0.0155798 0.0146386 0.0136276 0.0126332
0.0117216 0.0109398 0.0103037 0.0098068 0.0095067
        3   0.06396  0.677806     1245          30
0.0133541 0.0127109 0.0118723 0.0110908 0.0103875 0.0097649 0.0092146 0.0087223
0.0082725 0.0078517 0.0074494 0.0070576 0.0066717 0.0062889 0.0059079 0.0055291
0.0051530 0.0047810 0.0044143 0.0040548 0.0037041 0.0033641 0.0030364 0.0027231
0.0024258 0.0021461 0.0018857 0.0016456 0.0014267 0.0012296 0.0010541 0.0008999
0.0007660 0.0006512 0.0005539 0.0004724 0.0004048 0.0003493 0.0003041 0.0002677
0.0002386 0.0002156 0.0001976 0.0001837 0.0001732 0.0001655 0.0001601 0.0001566
0.0001545 0.0001538 0.0001540 0.0001550 0.0001566 0.0001586 0.0001609 0.0001635
0.0001661 0.0001688 0.0001715 0.0001741 0.0001766 0.0001789 0.0001812 0.0001832
0.0001852 0.0001870 0.0001887 0.0001902 0.0001916 0.0001930 0.0001942 0.0001953
0.0001964 0.0001973 0.0001982 0.0001991 0.0001998 0.0002005 0.0002011 0.0002016
0.0002020 0.0002023 0.0002025 0.0002025 0.0002024 0.0002021 0.0002017 0.0002011
0.0002003 0.0001993 0.0001982 0.0001970 0.0001958 0.0001946 0.0001936 0.0001929
0.0001927 0.0001933 0.0001948 0.0001977 0.0002023 0.0002092 0.0002189 0.0002321
0.0002497 0.0002725 0.0003017 0.0003386 0.0003845 0.0004407 0.0005086 0.0005892
0.0006831 0.0007902 0.0009099 0.0010406 0.0011800 0.0013253 0.0014731 0.0016198
0.0017619 0.0018960 0.0020190 0.0021285 0.0022221 0.0022984 0.0023559 0.0023941
0.0024123 0.0024105 0.0023890 0.0023484 0.0022897 0.0022143 0.0021240 0.0020210
0.0019082 0.0017884 0.0016652 0.0015418 0.0014220 0.0013089 0.0012057 0.0011148
0.0010384 0.0009781 0.0009352 0.0009110 0.0009066 0.0009234 0.0009636 0.0010294
0.0011242 0.0012518 0.0014167 0.0016240 0.0018790 0.0021873 0.0025544 0.0029853
0.0034848 0.0040567 0.0047038 0.0054277 0.0062282 0.0071027 0.0080456 0.0090468
0.0100911 0.0111562 0.0122116 0.0132182 0.0141286 0.0148898 0.0154486 0.0157594
0.0157943 0.0155512 0.0150585 0.0143723 0.0137761
        4   0.07373  4.418999     1245          11
0.0129854 0.0113708 0.0092356 0.0073297 0.0057543 0.0045100 0.0035509 0.0028194
0.0022622 0.0018359 0.0015073 0.0012516 0.0010505 0.0008906 0.0007621 0.0006578
0.0005722 0.0005014 0.0004422 0.0003924 0.0003500 0.0003138 0.0002826 0.0002556
0.0002320 0.0002113 0.0001930 0.0001767 0.0001623 0.0001493 0.0001377 0.0001272
0.0001177 0.0001092 0.0001014 0.0000944 0.0000880 0.0000823 0.0000772 0.0000726
0.0000686 0.0000651 0.0000622 0.0000597 0.0000578 0.0000564 0.0000555 0.0000551
0.0000553 0.0000560 0.0000571 0.0000588 0.0000609 0.0000635 0.0000665 0.0000698
0.0000735 0.0000773 0.0000813 0.0000854 0.0000894 0.0000935 0.0000974 0.0001012
0.0001047 0.0001081 0.0001113 0.0001143 0.0001171 0.0001197 0.0001221 0.0001245
0.0001267 0.0001289 0.0001311 0.0001333 0.0001356 0.0001379 0.0001404 0.0001431
0.0001459 0.0001490 0.0001523 0.0001560 0.0001600 0.0001645 0.0001694 0.0001748
0.0001808 0.0001875 0.0001949 0.0002032 0.0002125 0.0002229 0.0002347 0.0002480
0.0002633 0.0002808 0.0003011 0.0003249 0.0003531 0.0003868 0.0004277 0.0004780
0.0005407 0.0006202 0.0007223 0.0008554 0.0010309 0.0012647 0.0015784 0.0020002
0.0025656 0.0033160 0.0042935 0.0055314 0.0070386 0.0087811 0.0106671 0.0125450
0.0142235 0.0155118 0.0162667 0.0164279 0.0160244 0.0151533 0.0139491 0.0125506
0.0110786 0.0096270 0.0082613 0.0070218 0.0059292 0.0049890 0.0041968 0.0035413
0.0030075 0.0025789 0.0022389 0.0019721 0.0017649 0.0016056 0.0014845 0.0013936
```

Figure D1. (Sheet 2 of 6)

```
0.0013268 0.0012791 0.0012465 0.0012263 0.0012162 0.0012146 0.0012206 0.0012333
0.0012526 0.0012785 0.0013113 0.0013517 0.0014005 0.0014589 0.0015288 0.0016122
0.0017119 0.0018315 0.0019756 0.0021503 0.0023635 0.0026258 0.0029509 0.0033571
0.0038686 0.0045163 0.0053382 0.0063779 0.0076758 0.0092510 0.0110655 0.0129749
0.0146929 0.0158255 0.0160206 0.0151681 0.0139766
        5   0.08350  2.047490     1245          24
0.0090132 0.0081665 0.0068378 0.0054904 0.0042910 0.0033071 0.0025396 0.0019576
0.0015222 0.0011975 0.0009546 0.0007716 0.0006322 0.0005250 0.0004415 0.0003757
0.0003232 0.0002809 0.0002464 0.0002181 0.0001945 0.0001747 0.0001580 0.0001438
0.0001316 0.0001210 0.0001118 0.0001037 0.0000965 0.0000902 0.0000845 0.0000794
0.0000748 0.0000706 0.0000667 0.0000632 0.0000599 0.0000568 0.0000540 0.0000514
0.0000489 0.0000466 0.0000445 0.0000426 0.0000409 0.0000393 0.0000380 0.0000369
0.0000361 0.0000355 0.0000352 0.0000352 0.0000356 0.0000362 0.0000372 0.0000386
0.0000403 0.0000424 0.0000448 0.0000475 0.0000504 0.0000536 0.0000569 0.0000603
0.0000639 0.0000674 0.0000710 0.0000745 0.0000780 0.0000815 0.0000849 0.0000883
0.0000917 0.0000951 0.0000986 0.0001021 0.0001058 0.0001097 0.0001138 0.0001181
0.0001228 0.0001279 0.0001335 0.0001396 0.0001464 0.0001539 0.0001622 0.0001716
0.0001822 0.0001940 0.0002075 0.0002229 0.0002406 0.0002609 0.0002844 0.0003118
0.0003440 0.0003821 0.0004277 0.0004826 0.0005496 0.0006322 0.0007352 0.0008654
0.0010322 0.0012484 0.0015321 0.0019082 0.0024102 0.0030825 0.0039802 0.0051663
0.0067022 0.0086283 0.0109362 0.0135385 0.0162533 0.0188206 0.0209584 0.0224341
0.0231229 0.0230231 0.0222308 0.0208997 0.0191974 0.0172785 0.0152726 0.0132826
0.0113847 0.0096329 0.0080616 0.0066885 0.0055166 0.0045373 0.0037336 0.0030836
0.0025639 0.0021513 0.0018251 0.0015672 0.0013631 0.0012007 0.0010710 0.0009666
0.0008822 0.0008136 0.0007576 0.0007119 0.0006748 0.0006449 0.0006213 0.0006031
0.0005900 0.0005817 0.0005779 0.0005788 0.0005844 0.0005952 0.0006116 0.0006344
0.0006647 0.0007038 0.0007537 0.0008170 0.0008973 0.0009993 0.0011296 0.0012971
0.0015141 0.0017973 0.0021690 0.0026575 0.0032963 0.0041183 0.0051417 0.0063437
0.0076250 0.0087881 0.0095673 0.0097334 0.0094265
        6   0.09326  0.220654     1245           9
0.0095076 0.0087508 0.0076903 0.0066444 0.0056739 0.0048111 0.0040667 0.0034369
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0.0004103 0.0003775 0.0003485 0.0003226 0.0002995 0.0002787 0.0002600 0.0002431
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0.0001421 0.0001347 0.0001279 0.0001217 0.0001160 0.0001108 0.0001062 0.0001022
0.0000987 0.0000958 0.0000936 0.0000919 0.0000908 0.0000903 0.0000904 0.0000911
0.0000922 0.0000939 0.0000959 0.0000984 0.0001011 0.0001040 0.0001071 0.0001103
0.0001136 0.0001168 0.0001200 0.0001232 0.0001263 0.0001293 0.0001322 0.0001351
0.0001380 0.0001409 0.0001438 0.0001468 0.0001500 0.0001533 0.0001568 0.0001606
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0.0003461 0.0003743 0.0004071 0.0004453 0.0004904 0.0005438 0.0006077 0.0006844
0.0007774 0.0008904 0.0010284 0.0011972 0.0014034 0.0016544 0.0019577 0.0023203
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0.0077528 0.0083098 0.0087823 0.0091582 0.0094302 0.0095957 0.0096554 0.0096133
0.0094754 0.0092494 0.0089449 0.0085733 0.0081475 0.0076819 0.0071919 0.0066930
0.0062002 0.0057265 0.0052825 0.0048758 0.0045108 0.0041890 0.0039097 0.0036705
0.0034679 0.0032982 0.0031575 0.0030424 0.0029498 0.0028771 0.0028226 0.0027846
0.0027623 0.0027552 0.0027631 0.0027865 0.0028260 0.0028827 0.0029582 0.0030546
0.0031745 0.0033211 0.0034985 0.0037117 0.0039664 0.0042695 0.0046289 0.0050532
0.0055506 0.0061283 0.0067895 0.0075295 0.0083311 0.0091578 0.0099498 0.0106246
0.0110869 0.0112510 0.0110673 0.0105416 0.0099655
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0.0049716 0.0043811 0.0036759 0.0030746 0.0025728 0.0021598 0.0018224 0.0015477
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0.0000944 0.0000911 0.0000882 0.0000859 0.0000840 0.0000828 0.0000822 0.0000825
0.0000835 0.0000855 0.0000883 0.0000922 0.0000971 0.0001030 0.0001098 0.0001176
0.0001262 0.0001355 0.0001454 0.0001556 0.0001660 0.0001765 0.0001869 0.0001971
0.0002070 0.0002166 0.0002258 0.0002346 0.0002431 0.0002513 0.0002593 0.0002671
0.0002749 0.0002828 0.0002908 0.0002990 0.0003076 0.0003166 0.0003262 0.0003366
0.0003477 0.0003599 0.0003732 0.0003879 0.0004043 0.0004225 0.0004431 0.0004664
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```

Figure D1. (Sheet 3 of 6)

```
 0.0010021 0.0011513 0.0013424 0.0015892 0.0019096 0.0023263 0.0028673 0.0035646
 0.0044511 0.0055552 0.0068910 0.0084481 0.0101804 0.0120021 0.0137917 0.0154076
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 0.0117559 0.0101616 0.0086539 0.0072856 0.0060868 0.0050677 0.0042232 0.0035383
 0.0029924 0.0025636 0.0022308 0.0019754 0.0017815 0.0016363 0.0015297 0.0014537
 0.0014023 0.0013707 0.0013557 0.0013548 0.0013661 0.0013885 0.0014215 0.0014650
 0.0015191 0.0015847 0.0016628 0.0017551 0.0018634 0.0019905 0.0021395 0.0023144
 0.0025197 0.0027611 0.0030449 0.0033784 0.0037689 0.0042237 0.0047479 0.0053426
 0.0060012 0.0067051 0.0074193 0.0080897 0.0086457 0.0090103 0.0091176 0.0089335
 0.0084685 0.0077775 0.0069431 0.0060533 0.0053933
         8   0.11279  0.048882     1245          30
 0.0033814 0.0032315 0.0030117 0.0027778 0.0025399 0.0023067 0.0020845 0.0018774
 0.0016877 0.0015162 0.0013627 0.0012262 0.0011054 0.0009988 0.0009048 0.0008219
 0.0007487 0.0006840 0.0006267 0.0005757 0.0005303 0.0004896 0.0004530 0.0004201
 0.0003902 0.0003630 0.0003382 0.0003155 0.0002945 0.0002751 0.0002571 0.0002403
 0.0002246 0.0002098 0.0001959 0.0001827 0.0001702 0.0001584 0.0001471 0.0001363
 0.0001261 0.0001164 0.0001071 0.0000984 0.0000901 0.0000824 0.0000751 0.0000685
 0.0000624 0.0000568 0.0000519 0.0000476 0.0000440 0.0000409 0.0000385 0.0000368
 0.0000357 0.0000353 0.0000356 0.0000367 0.0000386 0.0000413 0.0000451 0.0000499
 0.0000557 0.0000628 0.0000710 0.0000805 0.0000910 0.0001025 0.0001149 0.0001280
 0.0001416 0.0001556 0.0001697 0.0001839 0.0001980 0.0002119 0.0002256 0.0002391
 0.0002523 0.0002654 0.0002784 0.0002913 0.0003043 0.0003175 0.0003309 0.0003447
 0.0003590 0.0003740 0.0003899 0.0004068 0.0004251 0.0004449 0.0004666 0.0004907
 0.0005177 0.0005482 0.0005834 0.0006243 0.0006725 0.0007303 0.0008006 0.0008875
 0.0009965 0.0011353 0.0013146 0.0015494 0.0018608 0.0022779 0.0028407 0.0036024
 0.0046310 0.0060062 0.0078100 0.0101053 0.0129007 0.0161092 0.0195146 0.0227720
 0.0254601 0.0271804 0.0276686 0.0268706 0.0249497 0.0222271 0.0190867 0.0158855
 0.0128935 0.0102738 0.0080927 0.0063460 0.0049873 0.0039525 0.0031758 0.0025980
 0.0021704 0.0018550 0.0016227 0.0014523 0.0013279 0.0012382 0.0011749 0.0011317
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 0.0011924 0.0012286 0.0012698 0.0013164 0.0013688 0.0014275 0.0014930 0.0015661
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 0.0026744 0.0028480 0.0030252 0.0032005 0.0033671 0.0035163 0.0036389 0.0037253
 0.0037672 0.0037585 0.0036968 0.0035840 0.0034705
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 0.0021392 0.0020510 0.0019176 0.0017733 0.0016263 0.0014832 0.0013488 0.0012260
 0.0011161 0.0010194 0.0009353 0.0008629 0.0008009 0.0007481 0.0007033 0.0006653
 0.0006331 0.0006059 0.0005829 0.0005635 0.0005471 0.0005333 0.0005215 0.0005116
 0.0005031 0.0004959 0.0004897 0.0004843 0.0004796 0.0004753 0.0004715 0.0004679
 0.0004645 0.0004612 0.0004579 0.0004545 0.0004509 0.0004471 0.0004430 0.0004386
 0.0004337 0.0004284 0.0004225 0.0004159 0.0004088 0.0004010 0.0003924 0.0003832
 0.0003734 0.0003630 0.0003521 0.0003410 0.0003297 0.0003186 0.0003079 0.0002978
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 0.0002724 0.0002783 0.0002859 0.0002949 0.0003054 0.0003171 0.0003301 0.0003443
 0.0003597 0.0003763 0.0003942 0.0004134 0.0004341 0.0004564 0.0004805 0.0005065
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 0.0092355 0.0108054 0.0125600 0.0144447 0.0163717 0.0182242 0.0198669 0.0211623
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 0.0013742 0.0014948 0.0016231 0.0017560 0.0018890 0.0020158 0.0021291 0.0022209
 0.0022836 0.0023109 0.0022996 0.0022495 0.0021896
        10   0.13232  0.120572     1245          30
 0.0004042 0.0004205 0.0004425 0.0004648 0.0004871 0.0005089 0.0005303 0.0005508
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 0.0006050 0.0005796 0.0005522 0.0005231 0.0004926 0.0004610 0.0004288 0.0003963
 0.0003639 0.0003319 0.0003009 0.0002710 0.0002427 0.0002162 0.0001916 0.0001691
 0.0001488 0.0001307 0.0001147 0.0001007 0.0000887 0.0000784 0.0000697 0.0000624
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```

Figure D1. (Sheet 4 of 6)

```
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0.0035879 0.0035433 0.0035518 0.0036237 0.0037712 0.0040093 0.0043572 0.0048387
0.0054831 0.0063240 0.0073967 0.0087329 0.0103518 0.0122479 0.0143775 0.0166471
0.0189096 0.0209741 0.0226298 0.0236821 0.0239924 0.0235088 0.0222789 0.0204398
0.0181891 0.0157443 0.0133050 0.0110258 0.0090043 0.0072840 0.0058658 0.0047237
0.0038184 0.0031074 0.0025509 0.0021148 0.0017716 0.0014996 0.0012821 0.0011065
0.0009634 0.0008456 0.0007479 0.0006660 0.0005971 0.0005386 0.0004888 0.0004463
0.0004098 0.0003785 0.0003516 0.0003286 0.0003089 0.0002921 0.0002780 0.0002662
0.0002566 0.0002488 0.0002429 0.0002387 0.0002360 0.0002349 0.0002353 0.0002372
0.0002406 0.0002454 0.0002518 0.0002597 0.0002692 0.0002802 0.0002928 0.0003070
0.0003227 0.0003399 0.0003584 0.0003782 0.0003936
       11   0.14209  0.530311    1245          30
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0.0001957 0.0002078 0.0002194 0.0002304 0.0002405 0.0002495 0.0002572 0.0002633
0.0002678 0.0002705 0.0002712 0.0002700 0.0002669 0.0002619 0.0002551 0.0002468
0.0002371 0.0002264 0.0002149 0.0002029 0.0001907 0.0001786 0.0001667 0.0001552
0.0001443 0.0001340 0.0001244 0.0001156 0.0001075 0.0001001 0.0000933 0.0000870
0.0000813 0.0000761 0.0000712 0.0000667 0.0000625 0.0000586 0.0000549 0.0000514
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0.0000211 0.0000212 0.0000215 0.0000220 0.0000230 0.0000243 0.0000260 0.0000284
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0.0003370 0.0002886 0.0002480 0.0002142 0.0001860 0.0001626 0.0001432 0.0001271
0.0001139 0.0001029 0.0000939 0.0000866 0.0000808 0.0000761 0.0000725 0.0000699
0.0000682 0.0000672 0.0000670 0.0000676 0.0000689 0.0000709 0.0000737 0.0000772
0.0000816 0.0000868 0.0000929 0.0000999 0.0001057
       12   0.15186  0.827381    1245           3
0.0002309 0.0002386 0.0002498 0.0002620 0.0002752 0.0002893 0.0003042 0.0003197
0.0003358 0.0003521 0.0003685 0.0003848 0.0004007 0.0004161 0.0004306 0.0004443
0.0004568 0.0004681 0.0004782 0.0004871 0.0004947 0.0005012 0.0005066 0.0005112
0.0005149 0.0005179 0.0005203 0.0005222 0.0005238 0.0005251 0.0005260 0.0005268
0.0005272 0.0005273 0.0005271 0.0005263 0.0005249 0.0005226 0.0005194 0.0005149
0.0005090 0.0005014 0.0004921 0.0004809 0.0004678 0.0004529 0.0004363 0.0004184
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0.0002519 0.0002382 0.0002260 0.0002152 0.0002059 0.0001980 0.0001915 0.0001864
0.0001826 0.0001802 0.0001792 0.0001796 0.0001816 0.0001851 0.0001903 0.0001976
0.0002071 0.0002191 0.0002342 0.0002530 0.0002763 0.0003049 0.0003404 0.0003844
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0.0042579 0.0042764 0.0042762 0.0042805 0.0043058 0.0043637 0.0044619 0.0046065
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0.0086489 0.0094099 0.0102018 0.0110027 0.0117872 0.0125290 0.0132028 0.0137864
0.0142621 0.0146159 0.0148378 0.0149206 0.0148598 0.0146538 0.0143054 0.0138231
0.0132218 0.0125226 0.0117514 0.0109365 0.0101049 0.0092805 0.0084820 0.0077222
0.0070085 0.0063436 0.0057269 0.0051558 0.0046265 0.0041355 0.0036797 0.0032572
0.0028671 0.0025094 0.0021844 0.0018924 0.0016332 0.0014059 0.0012088 0.0010397
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0.0003289 0.0003000 0.0002760 0.0002561 0.0002397 0.0002263 0.0002154 0.0002067
0.0002000 0.0001951 0.0001917 0.0001898 0.0001893 0.0001900 0.0001920 0.0001952
0.0001996 0.0002051 0.0002118 0.0002196 0.0002262
       13   0.16162  0.772112    1245          30
0.0000875 0.0000972 0.0001107 0.0001241 0.0001365 0.0001468 0.0001539 0.0001571
0.0001560 0.0001508 0.0001420 0.0001307 0.0001180 0.0001048 0.0000922 0.0000806
0.0000704 0.0000616 0.0000542 0.0000482 0.0000432 0.0000392 0.0000361 0.0000335
```

Figure D1. (Sheet 5 of 6)

```
0.0000315 0.0000300 0.0000288 0.0000278 0.0000271 0.0000266 0.0000262 0.0000260
0.0000259 0.0000259 0.0000261 0.0000264 0.0000270 0.0000278 0.0000289 0.0000305
0.0000325 0.0000353 0.0000388 0.0000434 0.0000492 0.0000564 0.0000651 0.0000751
0.0000861 0.0000974 0.0001080 0.0001166 0.0001222 0.0001242 0.0001223 0.0001171
0.0001094 0.0001002 0.0000903 0.0000806 0.0000715 0.0000633 0.0000562 0.0000501
0.0000450 0.0000408 0.0000374 0.0000347 0.0000327 0.0000314 0.0000306 0.0000303
0.0000307 0.0000317 0.0000334 0.0000359 0.0000396 0.0000447 0.0000517 0.0000615
0.0000753 0.0000951 0.0001240 0.0001675 0.0002345 0.0003406 0.0005118 0.0007912
0.0012438 0.0019525 0.0029845 0.0043185 0.0057678 0.0070058 0.0077360 0.0078644
0.0075101 0.0068825 0.0061661 0.0054765 0.0048685 0.0043586 0.0039443 0.0036164
0.0033646 0.0031809 0.0030611 0.0030057 0.0030210 0.0031212 0.0033312 0.0036911
0.0042628 0.0051375 0.0064414 0.0083318 0.0109677 0.0144432 0.0186818 0.0233354
0.0277579 0.0311233 0.0326770 0.0320190 0.0292692 0.0250267 0.0201387 0.0154042
0.0113592 0.0082185 0.0059500 0.0043953 0.0033694 0.0027138 0.0023120 0.0020860
0.0019861 0.0019816 0.0020529 0.0021851 0.0023636 0.0025689 0.0027735 0.0029408
0.0030283 0.0029977 0.0028285 0.0025299 0.0021411 0.0017189 0.0013174 0.0009730
0.0007004 0.0004969 0.0003511 0.0002494 0.0001793 0.0001312 0.0000982 0.0000752
0.0000592 0.0000479 0.0000398 0.0000340 0.0000300 0.0000271 0.0000253 0.0000242
0.0000238 0.0000240 0.0000249 0.0000264 0.0000286 0.0000315 0.0000354 0.0000403
0.0000463 0.0000537 0.0000625 0.0000728 0.0000814
```

Figure D1. (Sheet 6 of 6)

Appendix E
Notation

Text	Appendix C	
a_0		Normalizing coefficient in maximum likelihood estimate (MLE)
a_r		Normalizing coefficient for r^{th} iteration in iterative maximum likelihood estimator (IMLE)
A		Quartile asymmetry parameter
	`angle(na)`	Element `na` of an array that represents direction coordinates
$C_{ij}(f_n)$		Coincident spectral density between gauges i and j at frequency f_n
d		Water depth
	`datetime`	Ten-character string that contains date and time
	`dbar`	Mean water depth
	`ddf(nf,na)`	Array element representing the directional distribution function at frequency `f(nf)` and direction `angle(na)`
$d\theta$	`delang`	Direction increment
df	`delfs`	Frequency increment
	`dmax`	Maximum segment-averaged water depth in a collection

Text	Appendix C	
	`dmin`	Minimum segment-averaged water depth in a collection
$D(\theta_m)$		Directional distribution function based on $S(\theta_m)$
$D(f_n, \theta_m)$		Directional distribution function at frequency f_n and direction θ_m
$D_0(f_n, \theta_m)$		MLE estimate of directional distribution function at frequency f_n
$D_r(f_n, \theta_m)$		IMLE estimate of directional distribution function at frequency f_n after r^{th} iteration
$D_r'(f_n, \theta_m)$		Intermediate, uncorrected IMLE estimate of directional distribution function at frequency f_n during r^{th} iteration
$\hat{e}_x$		Unit vector in the x-direction
$\hat{e}_y$		Unit vector in the y-direction
	`fds(nf,na)`	Array element representing the frequency-direction spectrum at frequency `f(nf)` and direction `angle(na)`
f_n		n^{th} frequency of a set of N discrete frequencies
	`f(nf)`	Element `nf` of an array that represents frequency
f_p	`fp`	Peak frequency
g		Gravitational acceleration
	`gpat(nf)`	Element `nf` of an array of six-character strings that represent working gauge patterns
hhmm		Mnemonic for time of day
H_{mo}	`Hmo`	Characteristic wave height

Text	Appendix C	
i		Complex notation $\sqrt{-1}$ [in exponent or on main equation line]
		Gauge index [as subscript]
	idgfr	Degrees of freedom in cross-spectral estimation
	ifdtrnd	Flag indicating whether or not data have been detrended
	ifimle	Flag indicating if maximum likelihood or iterative maximum likelihood estimation is used
	ifwindo	Flag indicating whether or not data segments have been windowed
	istot	Total number of seconds duration of a time series
	iter(nf)	Number of iterative maximum likelihood iterations used to compute directional distribution at frequency f(nf)
I		Number of gauges in an array
$I(\theta_m - \theta_{m_{min}})$		Cumulative distribution function
Im[ ]		Imaginary part of complex entity contained in brackets
j		Gauge index [as subscript]
k_n		Magnitude of wave number vector associated with n^{th} discrete frequency
$\vec{k}_n(\theta_m)$		Wave number vector for wave direction θ_m at n^{th} discrete frequency
l		Summation index
m	na	Index associated with discrete direction
m_1		First cosine moment of $D(\theta_m)$
m_2		Second cosine moment of $D(\theta_m)$

Text	Appendix C	
m_{min}		Index of discrete direction at which wave energy is minimum
M	nang	Integer number of discrete directions
$M_{ij}(f_n)$		Element of dimensionless matrix of cross spectra between gauges i and j at frequency f_n
$M_{ij}^{-1}(f_n)$		Element of inverse of $M_{ij}(f_n)$
${}^{r}M_{ij}(f_n)$		Estimate of element of dimensionless matrix of cross spectra between gauges i and j at frequency f_n during r^{th} IMLE iteration
${}^{r}M_{ij}^{-1}(f_n)$		Element of inverse of ${}^{r}M_{ij}(f_n)$
n	nf	Index associated with discrete frequency
n_1		First sine moment of $D(\theta_m)$
n_2		Second sine moment of $D(\theta_m)$
	nband	Number of frequency bands averaged in spectral estimation
	nensb	Number of segments into which a data record is divided during spectral estimation
	nfft	Number of data points in a data segment
N	nfrq	Integer number of discrete frequencies
$Q_{ij}(f_n)$		Quadrature spectral density between gauges i and j at frequency f_n
r		Iteration count for IMLE
	rname	Five-character string denoting reference gauge
R		Upper limit of IMLE iterations
Re[ ]		Real part of complex entity contained in brackets

Text	Appendix C	
	`sf(nf)`	Element `nf` of an array that represents the frequency spectrum
	`sfrq`	Sampling frequency
$S(f_n)$		Frequency spectral density at frequency f_n
$S(\theta_m)$		Direction spectral density at direction θ_m
$S(f_n,\theta_m)$		Frequency-direction spectral density at frequency f_n and direction θ_m
	`thp`	Peak direction of directional distribution at frequency `fp`
T_p		Peak period
x		Horizontal coordinate increasing northward
$\vec{x}_i$		Horizontal position vector of gauge i
$\vec{x}_j$		Horizontal position vector of gauge j
y		Horizontal coordinate increasing westward
yymmdd		Mnemonic for date
β		Exponential convergence rate parameter in IMLE
γ		Convergence rate coefficient in IMLE
		Circular skewness
$\Gamma_{ij}^2(f_n)$		Coherence of signals from gauges i and j at frequency f_n
δ		Circular kurtosis
$\Delta\theta$		Quartile directional spread parameter
ϵ_r		Convergence check parameter at r^{th} IMLE iteration

Text	Appendix C	
θ_0		Mean direction
$\theta_{25\%}$		First quartile direction of cumulative distribution function
$\theta_{50\%}$		Median direction of cumulative distribution function
$\theta_{75\%}$		Third quartile direction of cumulative distribution function
θ_l		l^{th} discrete direction
θ_m		m^{th} direction of a set of M discrete directions
$\theta_{m_{min}}$		Direction of minimum energy
θ_p		Peak direction
$\lambda_r(f_n, \theta_m)$		IMLE correction factor at the r^{th} iteration
σ		Circular width parameter
$\phi_{ij}(f_n)$		Cross-spectral phase between gauges i and j at frequency f_n

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This report indexes characteristic parameters of and describes a means of access to 1,610 wind wave frequency-direction spectra observed at the Texaco Oil Company Harvest Platform during calendar year 1996. Located at about the 200-m depth contour approximately 20 km west of Point Conception, California, the platform supports a spatial array of six pressure gauges, data from which are processed with an iterative maximum likelihood directional estimator (IMLE). Nine parameters are defined, listed, and graphed in time series form: characteristic wave height, peak frequency, peak direction, four circular moments (mean direction, width, skewness, and kurtosis), and two parameters (directional spread and asymmetry) derived from quartile points of directional spectra. This report is the fourth and final in a series of annual reports summarizing IMLE-based directional spectra, and covers 1996 through early September when the array was taken off line for a major overhaul.

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